WATER QUALITY BUREAU REPORT

IDAHO LAKE MANAGEMENT GUIDE

Idaho Department of Health and Welfare
Division of Environment
Boise, Idaho

July 1987

Water Quality Bureau Report

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This guide was jointly developed by the Water Quality Bureau of the Division of Environment and the Panhandle Health District. Portions of this document were prepared by:

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ABSTRACT

The purpose of this report is to provide a working guide for the protection of Idaho lakes. It is designed to help concerned citizens identify problems and possible solutions, organize and set group goals and objectives, and initiate actions to preserve Idaho's valuable lake resources.

Information on lake environments is presented to foster a basic understanding of how lakes work. Lake management alternatives are discussed to show the kinds of actions that can be taken to solve lake problems. Agency responsibilities are reviewed to help groups obtain technical and financial assistance appropriate to their specific situation. Citizen involvement in lake management is discussed to guide groups in organizing, obtaining assistance, and initiating action.

Development of this lake management guide relied greatly on northern Idaho experiences. A grass roots lake management effort has evolved in northern Idaho in the last five years which has been very successful. This report documents that process for the benefit of other concerned citizens and lake protection groups. Although focused on northern Idaho, the concepts and approaches presented here are applicable statewide. The primary goal of this guide is to protect Idaho lakes from human-caused impacts by enhancing and expanding citizen lake management efforts that have already proven to be successful.

INTRODUCTION

Idaho has over 1,300 named freshwater lakes covering a total of more than 500,000 surface acres. The types and distribution of lakes include large, main stem river reservoirs in southern Idaho, high alpine lakes in the mountain areas of central Idaho, and developed recreational lakes in the Panhandle area.

Lake conditions vary from pristine to over-productive. Most of the reservoirs in Idaho were created to provide storage for agricultural irrigation water. Many suffer from degraded water quality due to excessive nutrient and sediment loading from irrigation return flows and agricultural runoff. High alpine lakes are pristine and generally not impacted by human activities. Signs of deteriorating water quality are most notable in the Panhandle area lakes. Although few are classified as "eutrophic", or over nourished, symptoms of eutrophication have been observed in localized areas.

Over half of the state's total lake surface area is found in the northern five counties. Cultural impacts, which are those caused by humans, are greatest since lakes tend to be the focal point for development in this part of Idaho. The high quality of life and recreational opportunities lake environments offer attract users from both Washington and Idaho.

Lakes in northern Idaho experience various impacts. Their shorelines tend to be heavily developed with recreational and year-round residences. Most homes use on-site wastewater disposal systems which can significantly impact water quality. Impacts from watershed land use activities are also important. Nonpoint source activities such as mining, agriculture, and forest practices are the most notable.

IDAHO'S LAKE MANAGEMENT PROGRAM

Active lake management in Idaho is just beginning. The state currently does not have a formal lake management program. A grass-roots movement, however, began in the late 1970's and continues to be the driving force behind lake management in Idaho today. Groups of lake property owners became concerned about the condition of their lakes and organized to take action in protecting them. The progress in lake management in the 1980's has been largely a result of this grass-roots effort. One of the challenges for the future is to build upon and expand these efforts to increase protection of Idaho's valuable lakes.

Development of the Idaho Lake Management Guide resulted from the success of the grass-roots lake management movement in northern Idaho. The process of local citizen organization to initiate action to protect area lakes is one that has worked. It has been recognized for its widespread value to others who are interested in protecting lakes. This guide puts into writing the grass-roots lake protection process to promote more of what has already been accomplished by lake protection groups. Completion of the guide is a major step in expanding Idaho's Lake Management Program.

This guide has been prepared jointly by the Water Quality Bureau of the Division of Environment and the Panhandle Health District. Two advisory groups were also used in completing the guide. The Water Quality Forum (WQF) is made up of technical representatives from resource management agencies in northern Idaho. The group was formed in 1985 to improve communication and coordination between agencies involved in water quality and related resource management. WQF is chaired by the Panhandle Health District with representatives from the Department of Fish and Game, Department of Water Resources, Division of Environment, Soil Conservation Service, Department of Lands, Forest Service, and the Corps of Engineers. WQF was used as a sounding board for the project and to provide input on the agency assistance section of the report.

The North Idaho Lake Association Coalition (NILAC) is made up of representatives from individual lake protection groups. This group was formed in 1985 to enhance citizen efforts toward lake protection through sharing experiences and information between lake associations and encouraging formation of new associations. NILAC was also used as a sounding board for this project. More importantly, the combined experiences of member lake groups of NILAC were used as the model in developing the guide. NILAC provided input on what they could contribute to lake protection and how resource agencies could assist them better.

The work of these agencies and groups was geared toward producing a working guide for lake management in Idaho. Focus was placed on citizen efforts to help guide existing groups in their activities and provide new groups with a "road map" to follow.

LAKE MANAGEMENT GUIDE GOALS AND OBJECTIVES

The primary goal of this Lake Management Guide is to protect Idaho lakes from human-caused impacts so that beneficial uses will be maintained for the enjoyment of future generations. Emphasis is placed on citizen efforts toward achieving this goal. A secondary goal of the guide is, therefore, to enhance and expand the grass-roots lake management movement already taking place.

Four objectives have been identified to achieve these goals:

1) Increase awareness and understanding of lake water quality problems and possible solutions,

2) Promote citizen group organization and action to protect lakes,

3) Improve agency assistance to citizen groups, and

4) Identify alternatives for solving lake water quality problems.

This guide has been organized to address each of the above objectives. Following the introduction is Chapter 1 on lake environments. Information is provided to foster a basic understanding of how lakes and lake watersheds work. This will enable citizens to evaluate conditions, possible sources of impacts and potential solutions to problems.

Chapter 2 deals with alternative ways of solving water quality problems. The lake management process is discussed as are short and long term lake management solutions.

Chapter 3 is a directory of resource agencies that may be able to help citizens in their efforts. Key areas of responsibility are identified and agency ability to provide technical and financial assistance is discussed.

Chapter 4 addresses citizen involvement in lake management. Information on organizing, actions individuals can take to reduce pollution, and citizen roles in the lake management process is presented. A handbook on organizing and building an effective lake association is included as Appendix A to provide additional details.

Chapter 5 deals with future lake management needs in Idaho. The focus of the discussion is on organizational options for getting solutions into place.

Finally, a collection of actual case studies is included in Appendix B. These are real life examples of what has been done by lake protection groups in Idaho and how they have done it. Contact people are listed to encourage other citizens or lake groups to take advantage of past experiences and guide them in their lake protection efforts. Appendix C provides one agency's, the Panhandle Health District, perspctive on lake management. Their insights and philosophy may also be of value to groups in pursuing lake management goals.

CHAPTER 1

LAKE ENVIRONMENTS

LIMNOLOGY - THE STUDY OF LAKES

Ecology refers to the study of organisms and their relationships to their surroundings or environment. An ecosystem, therefore, is the community of interaction between organisms and their environment. Limnology is that branch of aquatic ecology dealing specifically with the study of lakes. A lake is an ecosystem whose properties are the result of complex interactions between basic physical, chemical, and biological processes. Limnology, therefore, concerns itself primarily with describing these natural processes and their influence on the total aquatic ecosystem. Increasingly, limnology has focused on the influence of humans on these natural processes. The following serves as an overview of lakes as aquatic ecosystems, how they function, how they are studied, and the effects of human activities.

PHYSICAL CHARACTERISTICS

A lake is essentially a geologic basin that retains water. A lake occurs where water collects in an impermeable basin or where a basin extends below the level of groundwater saturating the earth. Lakes also occur as the result of natural or human blockage of river and stream channels. Certain physical characteristics and processes greatly influence the ecological characteristics of lakes. The most important are discussed here.

Lake Size and Shape

The size of a lake refers to its surface area. A body of water covering more than 50 acres (20 hectares) is commonly referred to as a lake. Water bodies covering less area are usually called ponds.

Maximum depth is simply the greatest distance from the water surface to the deepest point of the lake basin. Mean depth is the average depth of the lake basin; it is calculated by dividing the total lake volume by the surface area. These two values are important determinants of the ecological characteristics of a lake.

The shape of the lake basin directly influences its ecological qualities. A shallow lake may allow sunlight to penetrate to the bottom, making the entire bottom surface available for growth of attached plants. Sunlight penetrating through the entire depth of a shallow lake may also result in summertime temperatures suitable only for certain kinds of fish and other aquatic organisms. Wind and wave action may stir up bottom sediments containing nutrients which may then be cycled repeatedly through the food chain resulting in higher overall biological productivity in the lake ecosystem. In contrast, sediment and nutrients settling to the bottom of a deep lake are likely to remain there and be buried, unavailable for biological productivity. Only the upper waters of deep lakes are available for biological productivity; deep lake ecosystems are, therefore, generally less productive than those of shallow lakes.

Transparency

Sunlight is the energy source for most living systems. The process of combining inorganic raw materials such as carbon, hydrogen and, oxygen with solar energy into living organic matter is called photosynthesis or primary productivity. The amount of primary productivity occurring in a lake largely determines the nature of the entire lake ecosystem.

There is a general inverse correspondence between water transparency and productivity. Usually, the clearer the water the less productive it is. For this reason, water transparency is perhaps the single most important indicator of the nature of a lake ecosystem and is the simplest to measure.

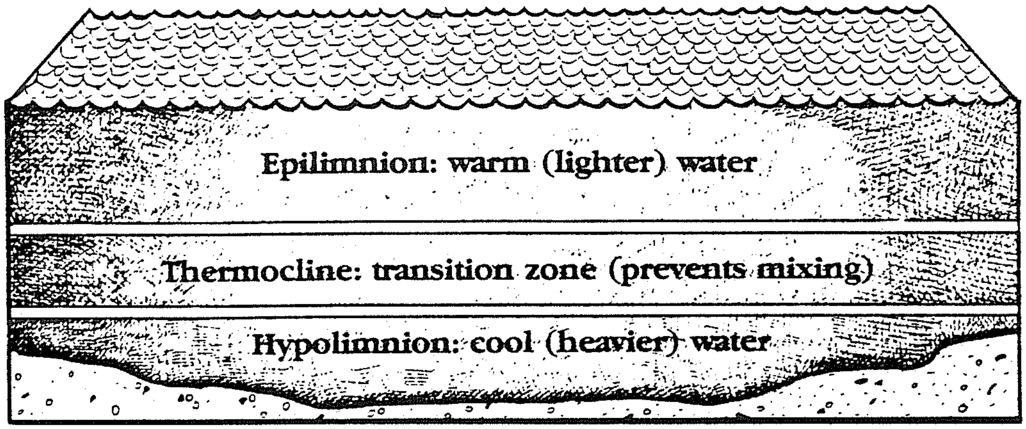
The characteristic blue color of a lake results from the optical properties of water and also gives a general indication of the lake's ecological conditions. The apparent color of a lake is a function of many things; dissolved and particulate substances (living and non-living) in the water, relection from the bottom and sky, and the wave length of unabsorbed light rays. Generally, rich productive lakes appear yellow to brown and pure unproductive lakes appear green to blue.

Thermal Stratification

Even the purest water absorbs some sunlight. Water through which solar radiation passes will be warmed and serve as the potential area for photosynthesis. Deep waters receiving no sunlight will remain cool. Because warm water is less dense, it tends to "float" on top of cooler, denser water. Deep lakes in temperate climates, therefore, tend to separate into distinct layers of warm upper and cool lower water during the summer, a phenomenon known as thermal stratification. The upper layer is called the epilimnion and the lower layer is called the hypolimnion. These layers are separated by a transition area called the metalimnion or thermocline (Figure 1). This middle layer is easily identified as it shows the most rapid decrease in temperature with depth of all layers.

Density differences between the upper and lower water layers of a deep lake are often so great that the energies of the wind and other external forces are not strong enough to cause mixing. Under conditions of strong thermal stratification, the deeper waters are isolated from the atmosphere with important implications to lake ecology. Only when the upper and lower waters are near the same temperature and, therefore, density can the wind or other external forces mix the lake throughout its entire volume. This mixing process is known as overturn and typically occurs only in the early spring and late fall in temperate climates.

Figure 1. Lake Stratification



From: A Citizens Guide to Lake Protection. Freshwater Foundation. 1985.

The most important ecological consequence of thermal stratification is isolation of the lower waters of a lake from the atmosphere. Algae and other organisms produced in the warm, sunlit upper layer die and settle out to the bottom. Bacterial decomposition of these organisms consumes oxygen dissolved in the waters of the lower layer. This region of the lake may thus become uninhabitable to fish adapted to cool, well oxygenated water. If this region becomes entirely devoid of dissolved oxygen it will only be habitable by certain bacteria and a few other tolerant life forms. Bottom waters, once depleted of oxygen, can only be replenished during periods of overturn. The extent to which these waters are depleted in dissolved oxygen depends largely on the amount of algae produced in the surface layer.

In general, lakes deep enough to stratify are less productive biologically than shallow, unstratified lakes. Primary productivity is determined by nutrient availability. In deep lakes nutrients initially present in the spring in surface waters are gradually depleted by algae. There is no replentishment of these nutrients as the season progresses. As organisms die and settle to the bottom the nutrients in their remains become dissolved or trapped in bottom sediments and are not available for more plant and algae growth in the surface layer.

Drainage Basin

The ecological characteristics of a lake are also influenced by its surrounding watershed or drainage basin. It is this area that provides a lake with its waters and plant and animal nutrients, largely through precipitation, erosion, and human land use. A lake with a large drainage basin area with respect to its surface area is likely to receive more sediment and nutrients and, therefore, be more productive biologically than a lake with a small drainage basin-to-surface area ratio. Lakes having similar drainage basin-to-surface area ratios can respond to watershed activities, however, differently if their total volumes vary greatly. A deep, large volume lake has a greater capacity for absorbing sediment and nutrients before showing signs of deteriorating water quality than a shallow, small volume lake.

The type of soils, vegetation, climate, the size of the human population, and patterns of land use also greatly influence lake ecology. The average water retention time in the lake is another important factor. This value is calculated by dividing the total volume of the lake by the total inflow of water over a given time period. Total inflow is proportional to drainage basin area and meteorological conditions. Retention time is basically a measure of how long it takes a lake to exchange its water volume. A lake with a high retention time exchanges its water volume very slowly. Pollutants, primarily nutrients and sediment, therefore tend to accumulate.

CHEMICAL CHARACTERISTICS

Most surface water contains a variety of dissolved substances. These include gases from the atmosphere and chemicals and minerals derived from weathering of soil and rock and biological processes.

Inorganic Ions

The vast majority of substances dissolved in surface water consist of simple inorganic ions or dissolved salts. The most common positively charged ions (cations) are sodium, potassium, calcium, and magnesium. The most important negatively charged ions (anions) are chloride, sulfate, and bicarbonate. The total concentrations and relative abundance of these ions vary widely and are the result of climate and geology. A useful measure of the total amount of dissolved ions in water is electrical conductivity; the higher the concentration of total dissolved substances the higher the conductivity.

Organic Matter

Natural waters can also contain dissolved organic materials. Such material can be quite complex chemically and often consists of excretions or decay products of animals and plants living in the water and/or the drainage basin. Most dissolved organic matter is rapidly decomposed into its simpler chemical components by bacteria and fungi. Some types, however, are more resistant to decay and can accumulate and exist for long periods of time. Examples of this type of dissolved organic matter are humic or fulvic acids, often called humus or humic matter. This type of dissolved material is most likely to come from swamps and waterlogged soils.

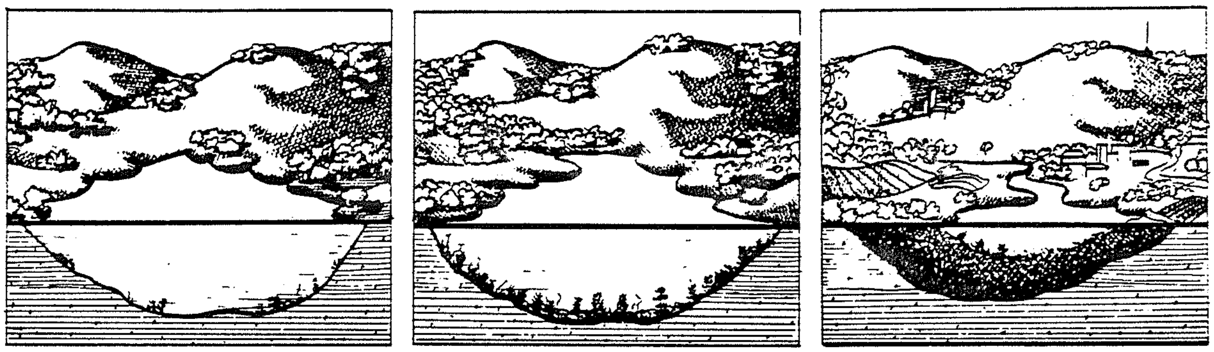
Nutrients

Ecologically, the most important substances dissolved in surface waters are the plant nutrients. Most substances needed by plants are present in amounts exceeding their needs and, therefore, do not limit plant growth or overall primary productivity. The most important plant nutrients are nitrogen and phosphorus. These two compounds are often present in very small amounts in nature so their availability can limit plant growth. Although it occurs in enormous abundance in the atmosphere, nitrogen must be in the form of nitrate or ammonia before most plants can utilize it. Phosphorus is derived only from erosion and other geological processes occurring in the drainage basin and is generally considered to be the nutrient most likely to be limiting to algal growth.

Lakes with low concentrations of primary nutrients generally support unproductive food chains and are described as oligotrophic or poorly nourished. Because nutrients are available in limited quantities, oligotrophic lakes usually respond quickly to additions of nitrogen and/or phosphorus by producing more algae. Lakes with an abundance of nutrients are described as eutrophic or well-nourished. Mesotrophic describes lakes between these two extremes (Figure 2).

Figure 2. Lake Eutrophication

Centuries Decades →



Natural Eutrophication | Cultural Eutrophication

From: A Citizens Guide to Lake Protection. Freshwater Foundation. 1985.

All lakes tend to progress toward eutrophy over time; that is, they become more productive. This occurs because sediment and nutrients are continually washing into them from their drainage basins. Lakes are not permanent features of the landscape. Over time they will fill with sediment and become shallow, then become swamps and wetlands, and eventually become dry land. This process of eutrophication is natural and generally irreversible.

Cultural eutrophication refers to the acceleration of the natural eutrophication process resulting from human influences. Nutrient enrichment is the consequence of greatest concern from human use of lakes and their watersheds. Sources of nutrients include human and animal wastes, fertilizers, and detergents. Agriculture, timber harvest, and land development can also increase nutrient delivery to lakes. Water clarity and other aesthetic values decline as a result of increased algal growth. Shoreline rocks and beaches become covered with algal slime. Oxygen levels may be depleted in the deeper parts of the lake with adverse effects on fishery and other aquatic life. Where it might have taken a lake ecosystem hundreds or thousands of years to reach high levels of productivity and its negative consequences, the activities of humans can accomplish it in years or decades. Countless examples of this phenomenon exist throughout the world.

Dissolved Oxygen

Oxygen dissolved in the water of a lake is vital to fish and other aquatic organisms. Even algae and plants need oxygen to live when they are not photosynthesizing. Plants and algae are a source of oxygen to lake waters during photosynthesis, but most oxygen comes from the atmosphere by diffusion through the lake surface. In lakes that stratify thermally, this occurs mainly during periods of spring and fall overturn. Oxygen is only marginally soluble in water. Solubility is heavily dependent on temperature, as temperature decreases oxygen solubility increases.

As already mentioned, eutrophic lakes often exhibit oxygen depletion in their deep waters in late summer. Bacteria, fungi, and other organisms consume the oxygen dissolved in the bottom waters to decompose the dead plant and animal material produced in the surface waters. In extreme cases, decomposition can consume all the oxygen dissolved in the bottom waters resulting in anoxic or anaerobic conditions (absence of oxygen). The result will be the death of all oxygen breathing organisms and a shift in lake aquatic life toward more tolerant organisms. Biological activity in this anoxic zone is restricted to certain bacteria capable of living without oxygen. Metabolic by-products of these organisms often include toxic substances such as ammonia and hydrogen sulfide with its characteristic rotten egg smell.

The absence of oxygen in bottom waters changes chemical conditions increasing the availability of nutrients. Under oxygenated conditions, phosphorus is normally bound to sediments. Without oxygen, phosphorus becomes soluble and can diffuse back into overlying waters.

In extreme cases the oxygenated surface layer is reduced to only a small part of the lake's total volume due to the processes mentioned above. Fall overturn may result in the entire lake volume containing too little oxygen for all but a few of the hardiest organisms to survive. In addition, the phosphorus released from the sediments may be sufficient to resupply the system for another growth cycle the following season. Eutrophic lakes too shallow to stratify are less likely to suffer oxygen depletion and its consequences. Dissolved oxygen, therefore, plays a very large role in the functioning of lake ecosystems and serves as a key descriptor of their characteristics.

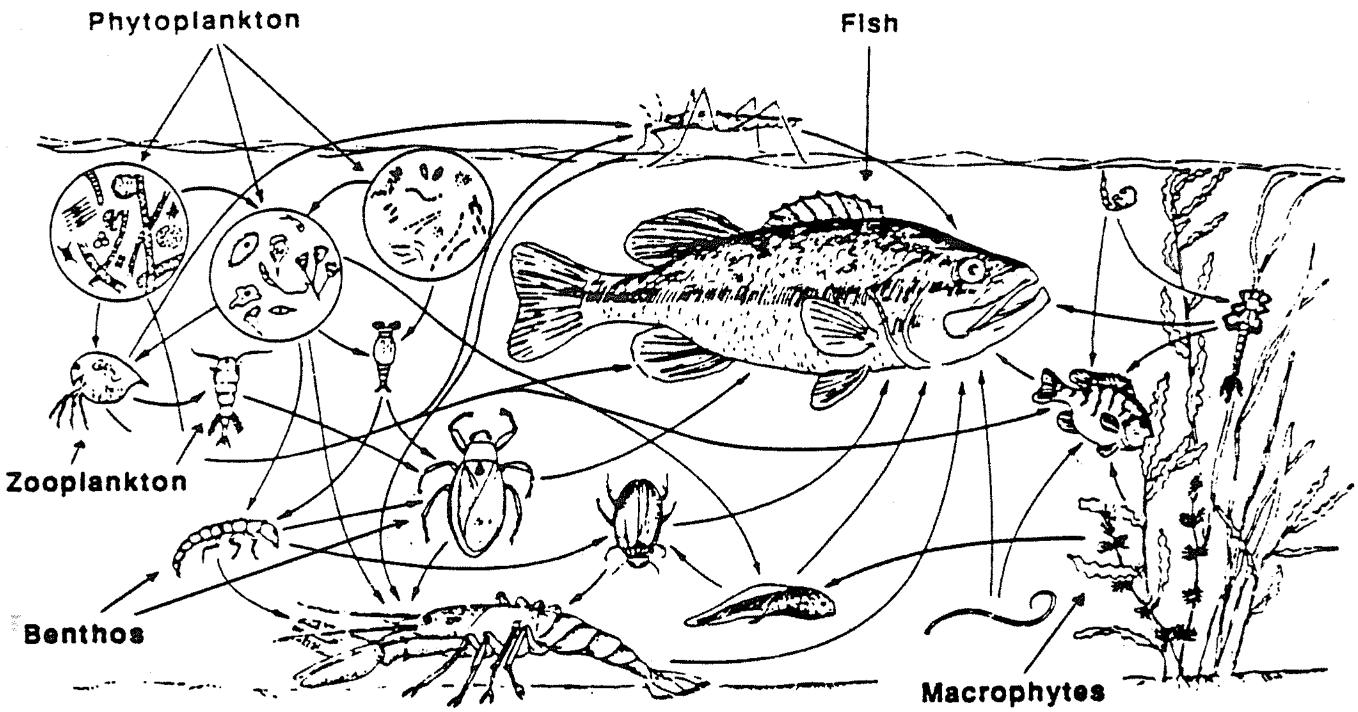
BIOLOGICAL CHARACTERISTICS

Phytoplankton

Algae are tiny plants found in nearly all surface water bodies throughout the world, both fresh and salt water. Algae are generally thought of as microscopic single celled plants, but many are colonial forms visible to the naked eye. They can grow in such profusion that the water is literally colored green. They can also grow in dense mats on solid or semi-solid surfaces. Like all other plants, they possess the ability to convert solar radiation and inorganic material into organic matter (the material of living things). They are the basis for subsequent levels of the food chain and are thus described as primary producers (Figure 3).

Algae are often collectively referred to as phytoplankton which, roughly translated, means "plant wanderer." Most do not possess effective means of locomotion and move according to the currents. The term phytoplankton is technically not applicable to those forms of algae that grow attached to solid surfaces such as rock, docks, and other objects. Periphyton is the term most often used to describe these algae.

Figure 3. Aquatic Food Chain



From: Acid Rain Study Guide. Wisconsin Department of Natural Resources. 1986.

Although technically the terms algae and phytoplankton are not interchangeable, their use and meanings have become so ingrained in aquatic ecology that they often are. For the purposes of this discussion, algae refers to all tiny photosynthetic organisms found in aquatic ecosystems, both free floating and attached.

There are vast numbers of different species of algae. A brief description of the major groups are presented here.

Diatoms and Green Algae

Perhaps the largest group is the diatoms. These are single celled, filamentous or colonial algae characterized by cell walls made of silica (glass) exhibiting intricate and beautiful shapes and structures. The next largest group is the green algae. They are restricted in distribution almost entirely to freshwater.

Blue-green Algae

The next most abundant group is the blue-green algae which more closely resemble bacteria than other algal forms. Many species of blue green algae can use nitrogen directly from the atmosphere for growth. This characteristic is unique to blue greens and gives them an advantage over other groups when nitrogen in surface waters is in limited supply. Certain species are associated with eutrophic conditions and often develop dense "blooms." Some strains of these bloom forming species can produce powerful toxins; however, toxic algal blooms are quite rare. The necessary conditions or the mechanisms triggering such events are not well understood, but seem to be associated with high nutrient concentrations and extended periods of relatively high water temperatures.

Euglenoids

The euglenoids are a fairly large and diverse group of algae but only a few are truly planktonic. They are found most often in shallow water rich in dissolved organic matter. Many species may derive nutrients by absorbing dissolved organic material. A few can even ingest solid particles (a trait most often associated with protozoa or single celled animals), making the distinction between plant and animal at this microscopic level a somewhat fuzzy one.

Dinoflagellates

The dinoflagellates are single celled algae that are capable of weak locomotion by means of flagella. Flagella are long whip-like structures that propell the organism through the water. While some are tolerant of a wide range of environmental conditions, most are found only within a narrow range of calcium and dissolved organic material concentrations, pH (acid-base balance) and temperature.

Cryptophytes

The cryptomonads are a small and little understood group. They are mostly planktonic algae and possess flagella. They often develop dense populations under conditions of low temperature and light.

The phytoplankton species present in a lake and their populations change throughout the year in response to changing conditions of temperature, light and nutrient availability, and other environmental factors. Over the winter, low temperatures and short days generally result in minimum annual phytoplankton population densities. Crypotomonads are often associated with conditions likely to occur in winter, but diatoms may also dominate. With the spring and its warmer temperatures and longer days, algal growth increases and the species composition of the community changes, although diatoms often remain dominant. As the summer growing season progresses, algal densities rapidly increase and species composition may change again.

Several different species may attain temporary dominance during the summer growing season. Phytoplankton densities often reach their annual peak in late summer and decline with the onset of fall. This scenario is simplified and can vary greatly among different lakes having similar characteristics. The seasonal phytoplankton cycle within the same lake can also vary from year to year depending on changes in other environmental factors.

The phytoplankton present in a lake is an extremely valuable indicator of the nature of that lake ecosystem, and allows for comparisons with others. The amount or density of algae is a measure of productivity or trophic state. In fact , the trophic state of a lake is largely defined by the rate of growth and the total amount of algae produced. The kinds of algae present serve as important indicators of specific environmental conditions because certain types or species occur only under certain conditions. Diatoms and green algae often dominate mesotrophic and oligotrophic lakes while blue-greens are more dominant in eutrophic systems.

Macrophytes

Aquatic macrophytes are plants larger than algae such as mosses and ferns. Large and/or colonial algal species such as Chara and Cladophora are also sometimes referred to as macrophytes; however, the term is most often applied to flowering plants assumed to be derived from ancestral land forms. In contrast to the algae, most aquatic macrophytes possess roots and stems allowing for attachment to the lake bottom. This characteristic allows the plant access to nutrient rich bottom sediments. Nutrients are taken up through the root system, incorporated into the biomass of the plant, and are ultimately released into the open water ecosystem in plant secretions and upon subsequent plant death and decomposition.

Macrophytes are confined to shallow water near the shore by their requirement for sunlight. Even in very transparent lakes, however, macrophytes are restricted to waters less than 35 feet deep because of their intolerance to high water pressure. Most aquatic macrophytes are also restricted to silt as opposed to rock bottoms.

Aquatic macrophytes are classified according to their habitats. Emergent macrophytes grow at the edge of lakes and streams and in wetlands with all or most of their stems and leaves above standing water. Members of this group are cattails and sedges. Floating-leaved macrophytes include the water lilies whose leaves float on the water's surface, attached by long stems to roots anchored to the bottom. A third group are the submerged macrophytes, a large and diverse group including many native species of pondweed and milfoil. Finally, there are macrophytes floating free on the surface such as duckweed. They are not normally attached and must draw their nutrients directly from the water much like algae. They are often found in nutrient-rich ecosystems.

In most instances the presence of macrophytes is normal and natural in lake ecosystems. A few introduced species, however, can develop in nuisance densities. Many macrophytes, both native and introduced are capable of reproducing from small fragments. Once established they are extremely hard to eradicate.

Zooplankton and Benthos

A vast diversity of aquatic animals consume the algae and macrophytes in lake ecosystems and serve as the link between the primary producers and higher levels of the food chain such as fish. The majority of these organisms are microscopic animals inhabiting the open water. They are collectively known as zooplankton, or "animal wanderers." Most can swim, but due to their size and other factors their distribution is governed largely by the currents. A lake ecosystem usually contains many different species. Some eat plant material and/or detritus (particulate organic material) while others eat smaller zooplankton. The most common zooplankton are rotifers or "wheel animals." The most prominant characteristic of these organisms is their "mouth" which is surrounded by cilia or hair-like fibers resembling the movement of a turning wheel under the microscope. Another common group of zooplankton are tiny crustaceans or "water fleas."

A second major group inhabits the bottom sediments; this group is collectively called the benthos. Benthic animals include insect larvae, snails, clams, crayfish, and worms. The benthic community is large and complex and their role in lake ecosystems is not fully understood.

Fish

Fish are generally at or near the top of the food chain in aquatic ecosystems. They in turn are preyed upon by the top of the terrestrial food chain such as raptors and other carnivores including humans. In addition to the popular sport game fish such as trout, bass, and others, there are many species of non-game fish inhabiting lake ecosystems such as suckers, dace, shiners, and sculpins. In general, eutrophic lakes exhibit higher levels of primary and secondary production. In comparison to oligotrophic lakes, eutrophic lakes produce more algae and plants (primary producers) which in turn serves as food for more zooplankton (secondary producers), which in turn serves as more food for fish (tertiary producers). There is that point in eutrophy, however, where excess primary productivity with its accompanying adverse effects results in shifts in fish species composition and perhaps elimination of certain species altogether.

TROPHIC CLASSIFICATION AND STATUS

Lakes are ranked and classified according to their biological productivity or trophic status. Unproductive lakes are described by lake biologists as oligotrophic, or poorly nourished. Eutrophic lakes are highly productive, or well nourished. Lake productivity is determined by many chemical and physical factors. The most important factors are probably the intensity of light in the surface waters and availability of essential plant nutrients, particularly nitrogen and phosphorus. The extreme ends of this trophic scale include very unproductive lakes described as ultra-oligotrophic and very eutrophic lakes described as hyper-eutrophic.

Characteristics of lake ecosystems are determined by extremely complex inter-relationships between chemical, physical, and biological factors. There is no single factor that determines or is a reliable indicator of trophic status. Numerous trophic classification systems have been developed over the years; Table 1 is one example. Research efforts have focused on several key variables to describe lake trophic status. The more commonly used indicators of trophic status are discussed here.

Table 1. Trophic Classification System

Trophic State	Phosphorus (micrograms/ liter)	Chlorophyll a (micrograms/ liter)	Secchi Disk Transparency (meters)	Primary Productivity ($mgC/m^2/day$)
ultra-oligotrophic	<3	<0.3	>16	<50
oligotrophic	3-9	0.3-2	7-16	50-250
mesotrophic	9-24	2-6	2-6	250-1000
eutrophic	24-75	6-40	0.75-2	1000-2000
hyper-eutrophic	>65	>40	<0.75	>2000

From: Wetzel 1983. Limnology (2nd edition).

Primary Productivity

The fundamental basis for the trophic classification of lake ecosystems is primary productivity. Technically, it is the rate at which inorganic carbon is converted into organic carbon compounds by photosynthesis. Put simply, it is the growth rate of the algae and plants that provide food for the rest of the aquatic food chain. That is why there is a direct relationship between the productivity of the fishery and trophic status. Eutrophic lakes generally produce more fish than oligotrophic lakes. Hyper-eutrophic lakes, however, are often suitable for only the hardiest of "trash" fish and environmental conditions may be so severe that no fish can survive.

Primary productivity occurs in the upper layers of a lake where sufficient light is available for photosynthesis to occur. Because lakes vary in transparency and, therefore, the depth to which photosynthesis occurs, it is common practice to report the rate of photosynthesis occuring over the area of the entire lighted surface layer. Primary productivity is, therefore, usually expresssed in terms of the amount of inorganic carbon converted to organic carbon per square meter of surface area per day.

Nutrients

Plants, like other organisms, require a number of nutrients from their environment to survive and grow. In aquatic ecosystems, the supply of nitrogen and phosphorus often limits plant growth and, therefore, the rate of primary productivity. Lakes with very little nitrogen or phosphorus in biologically available forms will not be very productive. Most often, phosphorus is in shortest supply and is the nutrient limiting to primary productivity. It is the single most important factor in determining ecosystem productivity and, therefore, trophic status.

Control of phosphorus has been the most successful strategy in controlling eutrophication. Nitrogen control has been less successful and is far more difficult because of the readily available supply from the atmosphere. Although atmospheric nitrogen is not in a form that can be used by most algae, there are common species that can convert it into biologically available forms.

Chlorophyll a

The amount and kinds of algae in a lake are important indicators of trophic status. The small amount of algae growing in oligotrophic lakes is generally comprised of diatoms. Mesotrophic lakes support larger total amounts of algae consisting of a variety of species of diatoms, green algae, and cryptophytes. Eutrophic lakes support high populations of algae often made up of a few blue-green species.

Algal density has been reported in many different ways including number of cells per liter of lake water, biovolume, milligrams of inorganic carbon per liter, dry weight of algal cells per liter, and micrograms of chlorophyll a per liter. Chlorophyll a is the main pigment in algal cells and is essential for photosynthesis or primary productivity. The amount of chlorophyll a extracted with acetone from the algal cells in a given volume of water is a widely accepted indicator of algal density.

Transparency

Water transparency is related to trophic status. The more algae that grows in the waters of a lake, the less transparent the water. For this reason, eutrophic lakes are generally less transparent than oligotrophic lakes.

Transparency is one of the simplest lake characteristics to measure. The most common measurement of transparency is secchi disk depth. This depth is determined by lowering a 20 cm black and white disk to the depth at which it disappears. The greater the secchi disk depth the greater the water's transparency.

The presence of suspended silt and clay or dissolved organic material may, however, decrease transparency and potential productivity by shading. In such situations, transparency may give a false indication of high productivity potential. Like most other characteristics of lake ecosystems discussed so far, transparency cannot be used alone in predicting biological productivity or assigning trophic status.

As can be seen, lakes are the result of complex interactions between many physical, chemical, and biological factors and processes. Human influences on these factors and processes and the extent to which these influences can be controlled are discussed in Chapter 2, Lake Management Alternatives.

CHAPTER 2

LAKE MANAGEMENT ALTERNATIVES

The properties and characteristics of a lake ecosystem are in large part determined by the kinds and amounts of materials transported from the surrounding drainage basin. Consequently, human activities and land use as well as natural phenomena occurring within a lake's watershed can profoundly influence lake ecology. Except for specific pollutants such as toxic chemicals, excessive amounts of nutrients are generally the cause of degraded or undesirable lake water quality. Thus, many lake management strategies are intended to prevent or control the transport and accumulation of unwanted nutrients.

Techniques are available for controlling or modifying the ecological effects of nutrients that have already entered a lake from the watershed. It is almost always preferable, however, to prevent unwanted changes in lake water quality rather than attempt to reverse those changes once they have already occurred. The old adage "an ounce of prevention is worth a pound of cure" is certainly true in lake management. A preventive approach to controlling unwanted changes in lake water quality is generally cheaper, easier to attain, and offers a greater degree of control and chance of success than a restorative approach. This section describes both approaches.

THE LAKE MANAGEMENT PROCESS

Lakes are suitable for many different uses. Those uses sometimes conflict with one another. For example, stimulation of algae growth is likely to increase fish production but decrease aesthetic values such as water clarity. The first and generally the most difficult step in any water quality management effort is identification of the important use or uses to be protected or managed. This can be a frustrating and complex process requiring involvement of all interested groups. Reaching a consensus often involves social and political issues in addition to water quality issues. Once uses are identified and management priorities are determined, a lake water quality management or protection effort can then begin.

The next step in lake management is determining what factors adversely affect beneficial uses. This step involves thorough and objective study by experts in the field of limnology. Such studies usually focus on the causes and magnitude of increased nutrient levels and the resulting unwanted effects. Nutrient loads to the lake from various sources are determined and their combined and individual effect on lake water quality is assessed. The feasibility of controlling specific sources of nutrients can then be evaluated and a prediction of the lake's response made. The last step in lake management is development of a plan for remedial action.

Lakes are complex ecosystems; therefore, no two are exactly alike. Though general tendencies and similarities can be identified, the information gained from one lake cannot usually be applied directly to others. In addition, the predictive capabilities of the biological sciences are not perfect. Further complications include limitations in analysis techniques and technology.

In a very large pristine lake, the effects of nutrient additions may be seen in a gross sense before a nutrient increase can be detected through actual measurement. For example, changes in water color and clarity indicating increased algae growth may be seen before chemical analysis can "prove" the existence of increased nutrients. Also, the total phosphorus analysis commonly used may signficantly overestimate the amount of phosphorus that is actually in a form available for plant and algae growth. The conclusion may be that conditions of undesirable nutrient enrichment exist when, in fact, they do not.

Identifying the causes of lake degradation and predicting the response of lake ecosystems to various remedial actions is, therefore, not always as "scientific" as the general public thinks or many scientists would like to believe. The process is best characterized as one of making as good an educated guess as available information and technology allows, by qualified and experienced individuals who are aware of the shortcomings and limitations of that information and technology.

There are also time, resource, and perception constraints associated with lake restoration efforts. People often take much too narrow a view in much too short a time frame, and often overestimate their abilities and/or underestimate the forces of nature. In some instances people cannot accept the fact that they are powerless and perhaps not meant to change the existing natural order. The public often wants immediate action and results. This is rarely possible and in certain circumstances not possible at all. It may take years to correct a condition that took years to create. Economics and availability of resources also play a role in lake management, as do societal values and political "processes". In spite of all these limitations, it is possible to at least responsibly manage lake resources and often restore valued beneficial uses.

CAUSES OF CULTURAL EUTROPHICATION

Eutrophication is the natural, irreversible "aging" process of a lake resulting from continuous inputs of nutrients and sediment over time. Eventually the lake will fill completely. This process can be greatly accelerated, however, by human activities in a lake's watershed. It is called cultural eutrophication and is probably the most common ecological problem facing lakes today.

Lakes are generally most sensitive to phosphorus enrichment because this nutrient is often in shortest supply. A small amount of phosphorus added to pristine lakes often produces rapid and dramatic increases in primary productivity. One pound of phosphorus in aquatic ecosystems can allow for the growth of 100-500 pounds of algae. Phosphorus inputs sustained over time generally result in overall increased ecosystem productivity and associated adverse effects and characteristics.

Sediment and nutrients from natural sources generally enter lakes in relatively small amounts on a continuous basis. Lake ecosystems, in combination with solar energy, are "driven" by the continuous natural input of nutrients. Lakes function for long periods of time in balance with these "background" or "base rate" inputs which are not easily controlled. Natural sources of nutrients to lake ecosystems include:

- erosional process occurring in the drainage basin
- decaying plant and animal material
- wildlife excrement
- dust and pollen in wind and precipitation
- recycling of nutrients contained in watershed soils and lake bottom sediments

In contrast, sediment and nutrient inputs from human activities often occur in large amounts over relatively short periods of time. They are easier to control than natural inputs, and are usually the targets of water quality management efforts. In fact, they are sometimes the only sources for which control is practical or possible. Sources of nutrients contributed by human activities include:

- sewage disposal
- fertilizer runoff from lawns and agricultural lands
- livestock and pet excrement
- urban and industrial stormwater runoff
- land disturbing activities (agriculture, timber harvest, mining, land development, construction)

PREVENTING EUTROPHICATION

The most effective point to control excessive nutrient and sediment inputs and their adverse effects is before they reach the lake ecosystem. The objective is to control the amount of nutrients reaching the euphotic zone of a lake in a biologically available form at a time when they can contribute to unwanted or excessive plant and algae growth. Nutrients associated with sediment carried by spring runoff may have little effect on lake productivity because they may be bound up in the sediment particles in a chemical form unusable by plants and algae, or quickly settle out of the euphotic zone. On the other hand, nutrients dissolved in the leachate from septic tanks of summer homes can have an immediate and profound effect on lake productivity and water quality. Some of the more common techniques for preventing excess nutrients from entering lake ecosystems are discussed here.

Diversion

Human-caused nutrient sources of highest concern are human and animal wastes, detergents and fertilizers in runoff and wastewater. The most effective method of preventing eutrophication is to divert or prevent such discharges from entering lakes.

Perhaps the best example of diversion in the northwest is Lake Washington in Seattle. Treated sewage discharged to the lake acted as a fertilizer, causing drastic decreases in water clarity and increases in plant and algae growth. Since diversion of the wastewater from the lake in the 1960s, water quality has improved dramatically.

Another example of diversion is Liberty Lake, near the Idaho-Washington border in the Spokane Valley. Too many septic systems close to the lake, in soils not capable of adequately removing nutrients were determined to be a major cause of lake eutrophication. A sewer and wastewater treatment system discharging to the Spokane River was built in the mid-1970s. In combination with other measures, water quality has since improved markedly.

Advanced Wastewater Treatment

Another strategy for preventing eutrophication is advanced wastewater treatment, which reduces wastewater nutrient concentrations to low levels before discharge. In the early 1970s the City of Spokane upgraded its wastewater treatment facilities to include phosphorus removal to protect water quality in downstream Spokane River reservoirs. As a result, Long Lake no longer exhibits severe and occasionally toxic blue-green algal blooms in late summer.

Product Use Control or Modification

Detergents and fertilizers can contribute large amounts of nutrients to a lake. Use of low phosphorus detergents and soaps in a lake watershed is sometimes effective in reducing eutrophication. There are examples of mandatory and voluntary bans in place today across the country. Controlled use of fertilizers containing only those nutrients in the amounts actually needed and applied at the proper times can also reduce lake eutrophication. Simple soil tests can be performed to determine application rates necessary.

Land Use

Many uses made of the land by humans contribute increased nutrients and sediment to aquatic ecosystems. These activities include agriculture and livestock, timber harvest and management, road building, land development and housing construction, energy production and conversion, mining and quarrying, manufacturing, and many others. It is almost impossible for humans to have no impact on their natural surroundings. This basic fact must be recognized and activities conducted accordingly to avoid degradation or outright destruction of those surroundings.

Among land management practices to be considered are:

1) Best Management Practices for minimizing the amount of sediment produced by logging, agriculture, grazing, land development, and construction activities.

2) Preservation of wetlands and strips of undisturbed vegetation to act as natural "filters" of sediment and nutrients.

3) Proper collection, disposal and treatment of human, livestock, and pet wastes.

4) Proper collection, disposal and treatment of urban, agricultural and industrial runoff, and wastewater.

5) Proper use of fertilizers and other chemicals in the minimum amounts necessary.

6) Proper location, installation, and adequate maintenance of subsurface sewage disposal systems to prevent nutrient impacts to adjacent water bodies.

7) Regulation of land use and development density around lakes based on water quality implications.

8) Community collection of leaves and trash for proper disposal away from water bodies.

REVERSING EUTROPHICATION

Once a lake has become eutrophic, there are a limited number of techniques available to reverse or control the process. These include dredging of nutrient-rich sediments, inactivation of nutrients with chemicals, artificial aeration of the hypolimnion, dilution and flushing with an outside source of low-nutrient water, and aquatic plant harvest and removal. In some cases, unwanted plant and algae growth has been controlled with herbicides. This approach, however, is expensive, cosmetic in nature, and potentially harmful to aquatic life.

Lake restoration techniques can vary considerably in their effectiveness. It must be recognized that some lakes are naturally eutrophic because they are very old or their drainage basins are naturally rich in nutrients. The condition of some lakes, in spite of the desires of humans, simply cannot be reversed. A brief discussion of several commonly used lake restoration techniques is given below.

Dredging

Dredging can improve trophic status by removing nutrient-rich bottom sediments. Physical deepening by dredging may also prevent the growth of attached aquatic plants.

Dredging may also be applicable in situations where a recently deposited sediment layer is contributing to internal nutrient recycling. During conditions of oxygen depletion, nutrients normally bound up in the sediments under oxygenated conditions are released and, after overturn, become available to plants and algae the following growing season. By removing the nutrient-rich sediment layer contributing those nutrients, the cycle may be broken.

Deleterious side effects of dredging, however, may outweigh benefits. Disposal of dredge spoils is often the most serious consideration. Dredging may temporarily increase nutrient releases by suspension and agitation of nutrient-rich sediments. Also, if fine grained sediments are removed leaving coarser grained sediments exposed, the nutrient absorption capacity of sediments may be lowered, reducing the lake's ability to "buffer" additional inputs. A reduction in water quality may actually result. . Thorough characterization of the lake's history, sediment profile, and the role of sediments in determining lake productivity is required when dredging is considered.

Nutrient Inactivation/Precipitation

Nutrient inactivation and precipitation by chemical means can actually reverse the eutrophication process. The technique can also speed up a lake's response to measures taken to reduce the nutrient inputs that initially caused eutrophication. Nutrient inactivation appears most appropriate where internal nutrient cycling from the sediments is a primary cause of a lake's eutrophic condition and where excessive nutrient inputs have already been controlled. It would make little sense to attempt lake restoration with this technique without first controlling the nutrient sources responsible for the lake's degraded condition.

The principle behind this technique is the same as that used to remove phosphorus from sewage in advanced wastewater treatment plants. The most commonly attempted nutrient inactivation technique involves the use of aluminum salts, usually aluminum sulfate (alum) and/or sodium aluminate. These chemicals are applied in powder or liquid form to the lake surface or its subsurface waters. They react directly with dissolved phosphorus to form an insoluble aluminum phosphate precipitate thus making the phosphorus unavailable to plants and algae. They also form an insoluble precipitate of aluminum hydroxide to which phosphorus becomes tightly bound, further reducing the amount of phosphorus available to plants and algae. Finally, this layer of aluminum hydroxide precipitate settles to the bottom creating a physical barrier thereby inhibiting the release of phosphorus in the overlying waters. The net effect of alum treatment is reduction of phosphorus available for plant growth and inhibition of internal nutrient cycling within the lake ecosystem.

The key to lake restoration using this technique is determining and delivering the chemical dose required to bring about a sufficient reduction in phosphorus for improved long-term water quality in a cost effective manner without toxic or adverse effects. The technique appears to result in significant water quality improvement in well researched, conscientiously engineered projects. Long-term effectiveness and adverse environmental effects, although researched, are as yet unknown.

Dilution/Flushing

Attempts have been made at reducing nutrient levels within a lake by dilution and flushing with low nutrient water. The technique either involves pumping water out of the lake, allowing increased inflow of nutrient-poor groundwater; or routing nutrient poor waters into the lake, thereby replacing nutrient-rich water with nutrient-poor water and flushing out excess algae growth. The second approach is by far the most common and perhaps most effective.

Dilution/flushing is effective in restoring or improving the quality of eutrophic lakes, especially if a continuous supply of nutrient-poor water is available and can be maintained. Two notable examples of this technique are Green Lake in metropolitan Seattle, Washington, where water from the municipal supply is used and Moses Lake, Washington, where low nutrient water from a nearby irrigation canal is routed through the lake without disrupting irrigation supplies. Significant water quality improvements have resulted in both lakes and are expected to continue if adequate flows of dilution water can be maintained.

Hypolimnetic Aeration

The goals of hypolimnetic aeration with compressed air as a lake restoration technique are to: 1) prevent oxygen depletion in the bottom waters of a lake without destroying thermal stratification, 2) increase available habitat for cold water fish and other aquatic life, and 3) prevent the nutrient release from bottom sediments that occurs under anaerobic conditions. Other than preventing internal nutrient cycling from bottom sediments, this technique does not eliminate the causes of eutrophication but instead prevents associated adverse effects. Due to recent advances in compressor techology and design of full or partial air lift aerators, it is quickly becoming one of the most popular and cost-effective methods of managing the consequences of eutrophication.

Artificial Circulation

Artificial circulation has been primarily used to prevent fish kills in shallow eutrophic lakes that otherwise freeze over entirely during winter months. Unlike hypolimnetic aeration, the goal of artificial circulation is to destroy thermal stratification resulting in increased temperatures throughout the water column and increased oxygen concentrations for bottom waters. The primary result is increased available habitat for warmwater fish.

Initially it was thought that artificial circulation would prevent internal nutrient cycling. It was also thought that by increasing circulation, algae growth would be limited because individual cells would be frequently outside of the zone of available light and subjected to rapid changes in water pressure. These effects are generally not observed and, in fact, the opposite often occurs.

Artificial circulation as a water quality management strategy appears most appropriate for increasing available habitat for warmwater fish and shifting species composition of the algal community away from noxious blue-greens which tend to dominate in eutrophic lake ecosystems. The literature also suggests that as a restoration technique, it may be best used alone and in situations where nutrient limitation is not a factor and cannot be accomplished.

Plant and Algae Control

Control of aquatic plants and algae through mechanical harvesting and chemical agents is another means of attaining or maintaining desired uses of a lake, particularly the near shore areas. It is generally regarded as an artificial or cosmetic approach because the underlying causes of plant and algae growth are not directly treated.

Rooted aquatic plants act as nutrient "pumps". Plants extract nutrients from bottom sediments through the roots. The nutrients are then released into the overlying waters in metabolic excretions. When the plants die and decompose, additional nutrients are released contributing to overall lake ecosystem productivity. Reduced lake productivity is, therefore, a conceivable result of continuous plant harvesting and removal, as nutrients contained in the plant biomass are removed from the lake ecosystem. This approach is increasingly viewed as a means of controlling lake productivity in certain situations.

In contrast, plant and algae control by chemical agents is entirely a cosmetic approach. It does little to reduce overall productivity because the nutrients contained in the plant biomass remain within the lake ecosystem and, therefore, remain available for further recycling. In fact, control of rooted aquatic plants with chemical agents may in the long term actually stimulate overall lake productivity. The plants killed with herbicides decompose, releasing into the waters nutrients extracted from the bottom sediments. This, in turn, stimulates additional plant growth which further "pumps" nutrients from bottom sediments into the overlying waters. Chemical aquatic weed control may, therefore, in the long term actually contribute to the problem it was initially used to solve.

The foregoing has been a brief discussion of some of the most commonly attempted lake restoration and management techniques. They are often used in conjunction with one another. The recommendations and decisions to employ them must be based on thorough study and the sound judgement of qualified and experienced individuals.

An excellent reference book on lake studies, management and restoration is Lake and Reservoir Restoration by Cooke, Welch, Peterson and Newroth, 1986. Individuals and groups interested in lake restoration and management are strongly advised to consult this book and others. If you need assistance in interpreting technical information in these references, you should contact experts in the field of limnology. State and federal regulatory and resource management agencies can help you, as can the staff of larger colleges and universities.

CHAPTER 3

AGENCY ASSISTANCE

The responsibility for protecting Idaho waters is shared by many units of government; federal, state and local. Water quality protection is achieved by managing land use activities adjacent to lakes and rivers and in the watersheds that drain into them. Activities that may impact water quality range from municipal treatment plant discharges (point sources) to forest practices, mining, agriculture, and urban development (nonpoint sources). The agencies and a brief summary of their respective responsibilities are given below. Agency programs where funding may be available for lake management activities are also identified. Offices to contact for more information on specific programs are included to guide lake protection groups in followup activities. Most state and local agencies have regional or area offices. Please refer to your local directory for the agency office in your area.

FEDERAL AGENCIES

U.S. Environmental Protection Agency (EPA)

EPA is the primary federal agency for coordinating programs to reduce environmental pollution. The agency has wide ranging authority that covers air and water pollution, solid waste management, pesticides, toxic substances, radiation, and noise control. EPA functions include: establishing and enforcing environmental standards; conducting research on the causes, effects, and control of environmental problems; and providing technical assistance to state and local governments. EPA also provides substantial funding to the states through annual grants to support state environmental protection programs.

EPA programs relating directly to lake management and restoration are the:

1) Clean Lakes Program authorized under Section 314 of the Clean Water Act,

2) Water Quality Management Program authorized under Section 205(j) of the Clean Water Act, and the

3) Nonpoint Source Control Program authorized under Section 319 of the Clean Water Act.

These programs are administered jointly by the state Division of Environment and EPA. For more information contact either agency listed below or the Division of Environment field office listed in your local directory.

U.S. EPA, Region X
Water Division
Office of Water Planning
1200 Sixth Avenue
Seattle, Wa. 98101
(206) 442-1354

Division of Environment
Water Quality Bureau
Statehouse
Boise, Idaho 83720
(208) 334-5867

U.S. Army Corps of Engineers (COE)

The Army Corps of Engineers administers two regulatory programs relating to lake protection. Through the Rivers and Harbor Act the Corps regulates construction activity in or over navigable waters of the United States. Activities could include construction of piers, boat launches, jetties or berms, and dredging. A permit must be obtained to conduct any construction activity below the mean high water mark.

Under Section 404 of the Clean Water Act, the Corps regulates the disposal of dredge and fill material to all waters of the nation including wetlands. Dredge and fill activities may include site development for recreation, industry or residences; property protection or reclamation such as installation of riprap, seawalls or gabions; and fill associated with the creation of ponds. A permit is required to conduct any of these dredge and fill activities whether the work is temporary or permanent.

The Corps jurisdiction over activities affecting rivers, lakes and wetlands is separate from that of state and local governments. The Corps does participate, however, in a cooperative program with the Idaho Department of Water Resources and the Idaho Department of Lands which also require permits for certain activities. A joint application form and pamphlet has been prepared for use by all three agencies. A listing of the necessary permits relating to water resource development and protection is shown in Table 2. For more information contact the agency office shown below or the one listed in your local directory.

Army Corps of Engineers
Regulatory Branch
City-County Airport
Building 605
Walla Walla, WA 99362
(509) 522-6720

U.S. Forest Service (USFS)

USFS, within the Department of Agriculture, manages the resources of our national forests and grasslands. Its primary purpose is to manage National Forest lands, wilderness, and recreation areas. It also cooperates with state government in enforcing game laws, in developing and maintaining wildlife resources, and evaluating water quality impacts from forest management activities.

Table 2. Permits Required for Activities Relating to Water Resource Developments*

Permitted Activity	Administering Agency
Stream channel alterations	Idaho Department of Water Resources
Construction activities in or over navigable waters	U.S. Arrmy Corps of Engineers
Dredge and fill activities into rivers, lakes, and wetlands	U.S. Arrmy Corps of Engineers
Encroachments on navigable lakes and reservoirs	Idaho Department of Lands

* Local planning and zoning ordinances may also exist that require permits to conduct similar activities.

The Forest Service is required to manage timber lands for multiple uses; however, current emphasis appears to be on timber management. Long term land management plans are developed that include an assessment of potential water quality impacts.

USFS is required by law to comply with state water quality standards administered by the Idaho Division of Environment. All the National Forests work closely with the Division in finalizing forest plans and designing water quality monitoring programs to evaluate impacts from forest activities. For more information contact the appropriate regional office shown below or the appropriate National Forest office listed in your area directory.

USFS Region I
200 E. Broadway
Missoula, Mt. 59807
(406) 329-3511

USFS Region IV
324 25th Street
Ogden, Utah 84401
(406) 329-3233

U.S. Fish and Wildlife Service (USFWS)

USFWS is a part of the U.S. Department of the Interior and is the primary federal agency responsible for conservation of the nation's fish and wildlife resources. The agency conducts research on fish and wildlife management, enforces federal laws such as the Endangered Species Act, administers federal aid, and provides technical assistance to state fish and wildlife agencies. USFWS also operates a public affairs and environmental education program to inform the public about fish and wildlife resources nationwide. For more information contact the agency office shown below or the one listed in your local directory.

USFWS
4620 Overland Rd.
Boise, Idaho 83705
(208) 334-1931

U.S. Geological Survey (USGS)

USGS is the geological, hydrological, and limnological research arm of the U.S. Department of the Interior. USGS publishes and distributes maps and reports describing physical land features and mineral, fuel, and water resources nationwide. USGS is the primary source for topographic maps available to the public. The water quality work performed by USGS is highly technical and research oriented.

All water quality data USGS collects is entered into EPA's data Storage and Retrieval System (STORET). The STORET database is used by the state water pollution control agency, the Division of Environment. Information already collected can be made available to interested parties on request. For more information contact either of the agency offices shown below or the one listed in your local directory.

USGS
Idaho-Nevada District Office
230 Collins Rd.
Boise, Idaho 83702
(208) 334-1750

Division of Environment
Water Quality Bureau
Statehouse
Boise, Idaho 83720
(209) 334-5867

Soil Conservation Service (SCS)

SCS of the U.S. Department of Agriculture (USDA) works through the local Soil Conservation Districts (SCD). There are 51 districts in Idaho. SCS provides resource data and technical assistance in soil and water conservation to land users in rural and urban areas. SCS publishes soil surveys and other resource information that might be useful in lake management decision making. SCS staff have extensive experience in soils science and can identify critical erosion areas and recommend management practices to reduce erosion. SCS can also provide technical assistance with determining the suitability of soil conditions to particular types of development. This assistance would be especially helpful to counties for development of erosion and sedimentation ordinances to complement zoning ordinances.

SCS administers several programs where funding may be available for lake management activities relating to water and land resource protection.

1) Small Watershed Projects (authorized under PL-566),

2) River Basin Studies, and the

3) Resource Conservation and Development Program (see below).

For more information contact the office shown below or the Soil Conservation District office listed in your area directory.

Soil Conservation Service
State Conservationist's Office
8th & Bannock
Boise, Idaho 83702

Resource Conservation and Development (RC&D)

The RC&D Program is a U.S. Department of Agriculture program administered by the SCS. The objective of the RC&D program is to improve the condition and use of land and water resources; the environment; and the economic, cultural, and recreational opportunities for area residents. This program provides financial and technical assistance to individuals, groups, and government entities throughout the area. For more information contact the RC&D office listed in your area directory.

STATE AGENCIES

Division of Environment

The Idaho Division of Environment, Water Quality Bureau, is the primary state agency responsible for protecting the quality of Idaho's surface and groundwaters. There are five regional field offices; located in Coeur d' Alene, Leiwiston, Boise, Twin Falls, and Pocatello and a central office in Boise.

The Environmental Protection and Health Act provides the Bureau broad authorities to protect Idaho's environment and promote public health. The act enables the Bureau to develop necessary rules, regulations, and programs to accomplish these goals.

The most comprehensive rules relating to water quality protection are the Idaho Water Quality Standards and Wastewater Treatment Requirements. Enforcement of these rules spans many program areas and is probably the Bureau's single most significant activity in achieving water pollution control goals. There are also program specific rules that regulate certain kinds of activities which may impact water quality.

The Water Quality Bureau's specific responsibilities to protect the quality of state waters include:

1) Developing and enforcing water quality standards and criteria for surface and groundwaters.

2) Developing and enforcing rules and regulations for activities that may impact surface or groundwater quality.

3) Certifying municipal and industrial discharge permits under the U.S. EPA's National Pollutant Discharge Elimination System (NPDES). The Bureau also conducts compliance inspections for some of these facilities.

4) Ensuring public drinking water supplies and systems are safe. The Bureau and five of the seven health districts administer this program. Activities include review and approval of system plans and specifications, compliance monitoring, staff and operator training, and enforcement of regulations.

5) Providing financial assistance to cities to construct sewage treatment plants. The Bureau administers both the state and federal municipal facilities construction grants programs.

6) Providing financial assistance to farmers to install conservation practices to protect water quality. The State Agricultural Water Quality Program provides grants to Soil Conservation Districts (SCDs) to contract with farmers for installation of Best Management Practices (BMPs).

7) Determining water quality conditions and sources of impact through monitoring.

8) Developing and implementing plans to control nonpoint sources of pollution to surface and groundwaters.

9) Evaluating various types of activity proposals that have the potential to impact water quality. Examples of proposed activities include mining plans, forest plans, environmental impact statements and environmental assessments, and various types of permits administered by other agencies.

Programs where funding may be available for lake management or related activies include the:

1) Municipal Facilities Construction Grants Program,

2) Agricultural Water Quality Management Program (This program is jointly administered by the Division and the state Soil Conservation Commission),

3) Water Quality Management Program, authorized under Section 205(j) of the Clean Water Act, and the

4) Federal Clean Lakes Program authorized under Section 314 of the Clean Water Act.

For more information contact the agency office shown below or the Division of Environment field office listed in your local directory.

Division of Environment
Water Quality Bureau
Statehouse
Boise, Idaho 83720
(208) 334-5867

Idaho Department of Fish and Game (IFG)

The Idaho Department of Fish and Game's (IFG) primary concern for water quality is associated with establishing, maintaining, or expanding fisheries in Idaho waters. Water quality and fish production are directly related; therefore, fisheries research by the department often includes monitoring key water quality parameters. Although IFG has no authority to abate pollution or control activities impacting water quality they work closely with the Division of Environment in developing water quality standards and management strategies to assure fisheries protection.

Fishing is an activity that most people can identify with. The IFG is a valuable resource agency in promoting successful fishing experiences and the need for protecting and managing Idaho's fisheries.

A possible source of funding for lake management or related activities is through the federal Dingell-Johnson Act and the Wallop-Breaux Amendments. This legislation taxes fishing and boating equipment and makes money available to the states for projects that enhance the public's enjoyment of water and fisheries resources. For more information contact the agency office shown below or the reigional office listed in your area directory.

Idaho Department of Fish & Game
600 S. Walnut
Boise, Idaho 83707
(208) 334-3700

Idaho Department of Water Resources (IDWR)

The Idaho Department of Water Resources is responsible for managing the quantity and allocation of waters of the state. IDWR administers the Stream Channel Alterations Act which controls alterations to stream channels below the mean high water mark. A permit is required and minimum standards must be met.

IDWR has three programs that could possibly fund lake management or related activities.

1) Water Resource Board Bonding Authority or Mirror Bond Program,

2) Water Management Account, and

3) Revolving Development Account.

There are specific eligibility criteria for each program. The objective of all programs, however, is to provide loans and, in some instances, grants to enhance water resource use or protection. For more information contact the agency office shown below or the regional office listed in your area directory.

Idaho Department of Water Resources
450 W. State St.
Boise, Idaho 83720
(208) 334-4440

Idaho Department of Lands (IDL)

The Idaho Department of Lands has management responsibilities over many activities that can adversely impact water quality. IDL administers the Forest Practices Act which authorizes a regulatory program for managing forest practice activities on state and private lands. Operators are required to notify the department of planned forest practice activities and to comply with the Forest Practices Act Rules and Regulations. IDL is also responsible for controlling mining activities through the Idaho Surface Mining Act and the Dredge and Placer Mining Act. Forestry and mining are watershed activities that can seriously impact water quality if conducted improperly. The regulatory programs in place can minimize these impacts with adequate enforcement.

Another responsibility the Department of Lands has that is more directly related to lake protection is administration of the State Lake Protection Act. The focus of this statute is to control any activity that encroaches upon, in, or above the beds or waters of navigable lakes or rivers of the state. A permit is required to conduct such activities. For more information contact the agency office shown below or the regional office listed in your area directory.

Idaho Department of Lands
State Capitol Bldg. Rm 121
Boise, Idaho 83720
(208) 334-3280

LOCAL AGENCIES

District Health Departments

Health Districts are responsible for issuing permits for subsurface sewage disposal systems and enforcing regulations for individual subsurface sewage disposal. Subsurface disposal is the predominant means of wastewater disposal around Idaho lakes. The Panhandle Health District has surveyed subsurface systems on all the major lakes and rivers in northern Idaho and is an excellent resource for determining management techniques for on-site sewage disposal.

There are seven Health Districts in the state, five have responsibilities for managing water supply systems with less than 10 connections. The majority of lake homeowners are in this category and seek help from the districts when problems arise.

Health Districts also handle solid waste and sewage facilities at public access points and commercial resorts. The districts also conduct an ongoing program concerning the incidence and control of disease which can involve water quality. For more information contact the Health District listed in your area directory.

County Planning and Zoning Departments

This is the unit of local government that develops the county comprehensive plan and the zoning ordinances to implement that plan. This entity is responsible for defining density along lakeshores and streams. The State Land Use Planning Act is the law authorizing these departments to conduct planning and zoning activities.

Lake environments are unique and require considerations not typical of more traditional urban planning. The water quality consequences of development decisions must be addressed in comprehensive plans. Water quality management expertise is crucial to sound planning and zoning, particularly in northern Idaho where lakes and rivers tend to attract development. There is a need to reevaluate existing comprehensive plans in light of the deteriorating water quality of many lakes in the last decade. Water quality based planning and zoning decisions in lake environments can be the most effective means of preserving and restoring high quality conditions. For more information contact the city or county planning and zoning department listed in your area directory.

Other valuable resources for lake protection are area academic institutions. The University of Idaho, Washington State University and Eastern Washington University are within a 150 mile radius of many northern Idaho lakes. Boise State University and the College of Idaho are the major institutions in southwestern Idaho. Major universities in the southeastern Idaho area are Idaho State and Utah State. These institutions, through their aquatic research and watershed management programs, can perform a valuable service in evaluating water quality conditions and potential sources of impact.

CHAPTER 4

CITIZEN INVOLVEMENT IN LAKE MANAGEMENT

The preceding chapters discussed the lake management process, various ways of preventing and reversing cultural eutrophication and agency assistance available to protect and restore lakes. This chapter focuses on citizen roles in lake management since the greatest accomplishments in lake protection can often be made through citizen organization and action.

DEFINING THE PROBLEM

The first step in lake management is recognition that a problem exists. Peoples' perceptions and values will differ; therefore, it is important that the views of the local lake community be known and agreement on the problem be reached. This concensus will be the initial step that brings the community together toward the common cause of lake protection or restoration. Appendix A contains details on organizing lake protection associations that will help groups get started.

During the early stages of organization it might be useful for your group to write down a plan of action. This will provide a guide to follow as the months go by and will help provide the group with a clear sense of purpose and direction. An example action plan is shown in Table 3. The plan should include a broad statement of purpose (goal), specific statements of the end results you are seeking (objectives), and a list of activities to be carried out to achieve those end results (tasks).

Table 3. Example Lake Management Action Plan

<u>Lake Management Action Plan</u>

Goal: Broad Statement of Overall Mission

Objective: Mini-goals that when achieved will meet the overall goal. Objectives should be stated as desired end results.

Task:	**Purpose**	**Responsible Party**	**Target Completion Date**
Specific things that will be done to achieve the desired end result or objective.			

Each task will have a purpose, a responsible party and a target completion date. This will assure that tasks are valid and there is accountability for completing work within reasonable time frames.

Action plans are simple but useful tools for planning, tracking, and evaluating progress toward the overall goal. Once developed, they should be reviewed regularly as priorities will often need reorienting and updating.

These plans can be very helpful to groups in seeking technical and financial assistance from resource agencies. They can serve as the basis for negotiating assistance and as a tool for coordinating and planning lake management efforts.

CHARACTERIZING THE PROBLEM THROUGH MONITORING

The next step in lake management is to determine the nature of the problem and the possible causes. A good place to start would be to look at existing data. The kind of information important to understanding lake conditions was presented in the first chapter of this guide. You may need to get help from trained experts to interpret this information. Look to the Division of Environment Water Quality Bureau or local university for help.

At this step a major decision point in lake management has been reached. Two questions need to be asked to determine the direction your group takes from here. Using the available watershed and water quality data and what you know of public perception:

1) Is lake water quality generally acceptable and are all the important beneficial uses or qualities being met or maintained or

2) Is the lake water quality less than acceptable and one or more of the beneficial uses or qualities impaired?

If the lake is characterized by the first statement, extensive monitoring is probably not warranted. It is, however, important to keep an eye on conditions which can be done through citizen lake monitoring. The Water Quality Bureau can assist you with this.

The last step of the process is to develop a management plan for your lake. If the lake is in good condition, management efforts should be focused on preventative and maintenance activities. Some of these activities were described in Chapter 2. Lake management actions that individual property owners can take are discussed later in this chapter.

If the lake is characterized by the second statement it will probably be necessary to collect more water quality information before developing a lake management plan. It is important that this work be done by qualified experts who know what information is needed to identify problems, problem sources, and develop appropriate management recommendations. There are several options citizens have to get these studies done. Some will require that the citizens group come up with part or all of the funding; others can be done through existing agency programs. Each of these options is discussed briefly below.

Area Colleges and Universities

Academic institutions can be the most economical way to get water quality studies done. Schools that have water resources, biology or limnology departments employ staffs with extensive technical expertise. Equipment costs and overhead are usually low and these schools are generally geared up to initiate work through ongoing research activities. Graduate students will usually conduct the field work which further reduces overall study costs. These students are closely supervised by trained professional staff.

Private Consultants

Environmental engineering firms or other private consultants trained in limnology can also be hired to conduct studies. Consultants tend to be more expensive but they can provide services to lake groups such as public relations and political negotiations that agencies and universities cannot. Qualified consultants generally have a great deal of experience in implementing lake restoration alternatives.

Resource Agencies

There are many water quality and related programs in place that could help citizens complete lake studies. Many of these are listed in Chapter 3 of this guide, Agency Assistance. The federal Clean Lakes Program funds water quality studies to determine sources of impacts and develop and install management alternatives for solving lake problems. The state Agricultural Water Quality Program can do the same for lakes suffering primarily from agricultural impacts. Resource agencies who monitor for purposes other than water quality may be able to incorporate local monitoring concerns into their ongoing monitoring programs.

Citizen Monitoring

Simple monitoring programs can best be conducted by citizens who live around or near the lake of concern. Dedicated individuals are required for this type of monitoring program to be successful. Citizen monitoring is most useful for keeping tabs on conditions when lake quality is good to make sure it does not worsen and as a followup to comprehensive studies done by experts.

A citizen lake monitoring program has been designed by the Water Quality Bureau and is scheduled to begin the summer of 1987. If you are interested in participating in this program, contact the Division of Environment office in your area or the Clean Lakes Coordinator in the Boise central office.

The purpose of the water quality study is to evaluate lake conditions and identify sources of impacts. Identifying sources of impacts will require a look at shoreline and watershed activities. Ideally this should be done at the same time the water quality study is conducted. This can be done as a separate step if study costs require that the work be spread out over a longer period of time.

Completion of the water quality and watershed studies leads into the last step of lake management, development of the lake management plan. This plan involves identifying and documenting the actions necessary to solve water quality problems.

CITIZEN ACTIONS TO SOLVE LAKE WATER QUALITY PROBLEMS

Many management alternatives have been discussed in Chapter 2. There are many others that involve voluntary actions by lakeshore and watershed property owners and lake users. Some of these practices are described below. There may be others but the important thing is that these measures can be taken immediately and can make a real difference in water quality.

Septic System Care

Do not let your septic system pollute the lake. If your system is antiquated, it may need upgrading. Septic systems must be properly installed and maintained to function correctly. Some warning signs of system failure to watch for are:

- sewage odor
- slow running toilets and drains
- a bright green patch of grass over the tank
- puddling water over the drainfield area

Some preventive steps you can take to make sure your system operates efficiently are:

- When installed, make sure your system is properly sited and designed by a licensed professional.
- Have the tank pumped regularly; every 3 to 5 years.
- Avoid use of phosphate detergents.
- Conserve water.
- Do not use your garbage disposal.
- Do not plant trees and shrubs over the drainfield; roots can crack or clog pipes.

Any concerns about the operation of your system should be directed to the local Health District .

Laundry Products and Household Cleaners

Phosphates are a main ingredient in household soaps and detergents responsible for getting clothes "white" and "bright." Unfortunately, phosphates are also responsible for excess algae and aquatic weed growth in lakes and streams. Try to minimize your use of products containing phosphates. Check the label and select products with low or no phosphates (<0.5 %). Here is a list of popular products low in phosphates.

- Laundry detergents - Ajax, All, Arm and Hammer, Dynamo, ERA Plus, Ivory Snow and Flakes, Purex, Tide liquid, Wisk and Sun

- Cleansers - Ajax, 409, Bon Ami, Comet, Fantastic, Mr. Clean, Pine Sol and Soft Scrub
- Dish soap - Ajax, Dawn, Ivory liquid, Joy, Lux, Palmolive and Sweetheart

In addition to careful product selection and usage you should not wash anything directly in the lake or at the lakeshore. This includes dogs, horses, and boats. These activities are a direct source of phosphate to lake waters as there is no benefit of treatment through a septic system.

Yard Care

Yard care products can also be harmful to lake environments. Fertilizers contain phoshorus and nitrogen which, if over-applied, can runoff or leach into lake waters and stimulate plant growth. Herbicides and pesticides can be toxic to aquatic life. Some ways to reduce the impact of these products on lake water quality are:

- Limit use of fertilizers to only the amount your lawn and plants need. Over application will just wash away into the lake.
- Follow the directions closely.
- Dispose of containers and unused products properly.
- Use organic fertilizers where possible.
- Encourage natural pest predators in your yard.
- Think twice about putting in a lawn if you do not already have one. Natural landscaping can enhance the beauty of your lake environment, reduce the upkeep, and eliminate some of the impacts that result from maintenance activities.

There are also several precautions to observe in handling yard refuse. Keep landscape and lawn trimmings from washing into the lake. Do not burn leaves or other refuse on the beach. Ashes can easily wash into the lake, providing a source of excess nutrients for nuisance plant growth.

Boat Use

Motor boats can be a direct source of nutrients to lake waters through exhaust emissions or an indirect source by agitating nutrient rich sediments. Some operational and maintenance tips that can reduce motor boat impacts on lake water quality are:

- Keep boat engines well tuned.
- Promote use of electric trolling motors.
- Promote use of 4-cycle engines over 2-cycle engines.
- Do not pump bilge water into the lake.
- Reduce speed in shallow areas to prevent sediment agitation.
- Use pump-out facilities at service docks for boat toilets
- Prevent fuel leaks and spillage from filling tanks

Aquatic Plant Control

Aquatic plant growth is one of the bigger nuisances to lakeshore property owners that results from eutrophication. Plant growth interferes with swimming, boating, and fishing which are the pastimes that attract people to live around lakes in the first place. Steps homeowners can take to control and sometimes reduce the spread of these nuisance plants are:

- Harvest plants by hand or by raking. Be sure you remove the plants from the water and dispose of them properly (compost or sanitary landfill).
- Remove plants using a mechanical harvester. These are "aquatic combines" that cut and collect the plants for proper disposal on land.
- Use Aquascreen®, a mesh material laid on the lake bottom to prevent root establishment.

There are also aquatic herbicides available to control plant growth. These are only recommended as a last resort as there can be unknown secondary effects to other aquatic life. Consult your county agricultural extension agent for advice on the use of these products.

Land Use Activities

Any land disturbing activity in shoreline areas or in the watershed has the potential for polluting lakes. The main concern is to control runoff, erosion, and sedimentation from these activities. By controlling these processes nutrient inputs to lakes will also be controlled.

The most common land uses affecting lakes are construction activities, forestry, agriculture, grazing, and mining. Practices for controlling impacts from each of these activities have been developed. The more common practices are listed here.

- Stabilize disturbed areas as quickly as possible. This could include preserving existing vegetation, revegetating, or using jute or straw.
- Keep the soil from running off the development or construction site. This could include use of sediment basins or traps, silt screens, or straw bales.
- Preserve wetlands and marshes for their natural filtration properties and for wildlife habitat.
- Preserve streamside or lakeshore natural vegetation to serve as a buffer zone.
- Prevent direct animal access to streams and lakes. This could involve fencing, building confinement structures, or developing alternative water sources.
- Minimize erosion from agricultural activities. This could involve contour plowing, minimum tillage, crop rotations, grassed waterways, sediment basins, and avoiding cultivation of steep slopes.

Good land stewardship requires that landowners be aware and understand the possible impacts their activities may have on water quality. Impacts can be controlled or reduced by taking steps to preserve as much of the natural environment as possible or prevent runoff and associated pollutants from reaching rivers and lakes. If you are interested in detailed practices to control impacts from specific land uses, refer to Chapter 3 to find the appropriate agency to contact.

CITIZEN ROLES IN THE LAKE MANAGEMENT PROCESS

The preceding discussion focused on things citizens can do directly to reduce the impact of their activities on lake water quality. There are several other roles citizens play in the lake management process that are more indirect in nature but vital to the success of lake management efforts. The most important of these are: 1) education, 2) communication and coordination, and 3) political involvement. Each of these is discussed below.

Education

Citizens must continue to inform themselves about how their activities and the activities of others affect lake quality and how to alter that behavior and those activities adversely affecting water quality. Be an information resource to your neighbors; share what you know.

Citizens groups can initiate activities that promote water quality protection and awareness. For instance, citizen groups and resort owners can build informational signs at beaches, resorts, and boat access points or distribute brochures and leaflets with tips about protecting water quality during times of peak summer use. Homeowner groups can institute a program of informing its members about the use of phosphate-free detergents, of minimizing fertilizer use, of leaf disposal mehtods other than burning them on the beach, and of the importance of regular septic tank maintenance. Homeowners can explore means of encouraging farmers to keep livestock away from streams and lake shores or of promoting responsible use of power boats. The list of activities is limited only by the creativity and energy of the group.

Citizen groups need to take full advantage of educational opportunities resource agencies can provide. Ask for information and assistance. Agency personnel are there to serve the public. Be specific and persistent in your request for assistance.

Another excellent source of educational material is the North American Lakes Management Society (NALMS). This society is made up of professionals, academicians, lake associations, and individuals who care about lake protection. NALMS has a wealth of information, experience, and contacts to offer.

Finally, do not forget your area schools; both secondary and higher education. They represent a pool of professional educators and are likely to have staff experienced in lake management or related fields that could be of great value to your group.

Communication and Coordination

It is important that an ongoing relationship be established between citizen groups and resource agencies. There is rarely a limit to desire and concern for lake protection but there always seems to be limits on time and money. The better the communication of desires and coordination of efforts the greater the chances of protecting and improving lake quality .

It will be frustrating for citizen groups to find their way through the bureaucratic maze but persistence will pay off. There are numerous agency programs for getting lake problems solved. All options must be kept open and fully explored.

Communication and coordination between lake groups is also a key ingredient to enhancing lake management efforts. Groups can share information and experiences and provide direction to newly forming groups. Pitfalls can be avoided and progress can be accelerated.

Political Involvement

Citizens concerned about lake water quality must continue demanding that the quality of Idaho's waters be protected and wisely managed for the present and future through the political process. Citizens can encourage their elected officials to support establishment of a lake protection, management and restoration program in Idaho or that existing programs and adequate resources be devoted to such purposes. Citizens can exert pressure on state and federal resource management agencies to conduct their activities in such a manner that water quality is given full consideration and protection. Citizens can petition local authorities to ensure that land use and development is conducted in such a manner that lake water quality is considered and protected. One of the greatest powers citizens have is their vote. State and local political leaders must recognize and address the serious lake management issues facing Idaho today.

Citizen commitment to clean lakes in Idaho is what spurred the development of this lake management guide. The intent of the guide is to document the "grass-roots" lake management process that has evolved in Idaho over the last five years for the benefit of others. Its content was chosen to help citizens continue in their efforts to protect and restore Idaho lakes by: 1) increasing understanding of how lake watersheds and lake ecosystems work, 2) increasing awareness of technical and financial resources available to assist their efforts, and 3) increase awareness of their power to effect improvements in water quality directly and indirectly through the political process. We hope you find this material useful and wish you success in your endeavors to protect Idaho's beautiful lakes.

CHAPTER 5

FUTURE LAKE MANAGEMENT NEEDS

Idaho's "grass roots" Lake Management Program has been quite successful. The experience gained has brought to light, however, some necessary considerations for the future. Many of Idaho's program needs are organizational, ranging from the local to the state level. Although citizen groups have been very effective in initial actions toward lake protection, implementing actual solutions has for the most part been beyond their financial means.

Creative ways must, therefore, be sought to pay for the lake protection and restoration work needed. Several organizational alternatives have been identified and include: 1) formation of Recreational Lake Management Districts, 2) diversification of county level public works functions, and 3) establishment of a state Clean Lakes Program to fund lake management projects. A federal Clean Lakes Program is already in place and recent changes have increased Idaho's ability to participate. A more detailed discussion of each alternative follows.

Recreational Lake Management Districts

Formation of lake management districts would create local taxing capabilities to finance lake water quality studies and improvement projects. Legislation would be required to authorize the formation of such districts which would operate similar to other types of special use districts such as sewage management districts.

Some of the benefits of forming a lake management district include: 1) increased public awareness and accountability for watershed and lake water quality problems, 2) ability to finance and/or conduct small scale lake management projects, and 3) ability to receive state and federal grants to conduct lake management and restoration activities.

Lake management districts have been authorized in many other states and have worked successfully. A nearby example of this approach to increasing protection for lakes is the state of Washington.

County Public Works Functions

Many of Idaho's lakes are impacted from on-site subsurface sewage disposal. Some of these problems have been corrected through establishing small community sewage collection and treatment systems. A major drawback of this approach has been that once installed there is no public entity to assume responsibility for system maintenance and operation.

Small sewage districts have not budgeted to hire maintenance people, as a result their equipment often falls into disrepair. To remedy this problem, the county could hire a "circuit rider" to service multiple systems. This circuit rider could be funded by one or several counties out of service fees. The position would be entirely self-supporting.

The benefits of this approach to wastewater management are multiple: 1) smaller problem areas could be sewered avoiding the higher cost of large scale collection and treatment, 2) equipment could be standardized to provide more efficient delivery of maintenance services, and 3) provisions for utility services could be tied to the county comprehensive plan, zoning and subdivision ordinances, and building codes.

State Clean Lakes Program

The cost of managing and restoring lake water quality can be tremendous. Even with the formation of lake management districts, outside financial assistance will probably be needed. Existing sources of funding need to be pursued more vigorously and new ones developed. Establishing a state Clean Lakes Program would provide another option for financing lake management projects. The state of Washington operates a program that is recognized nation-wide which could serve as a prototype for developing an Idaho program.

The Idaho Division of Environment currently administers a dedicated fund for other types of water quality improvement projects. This fund, the Water Pollution Control Account, is used to finance construction of sewage collection and treatment facilities and implementation of agricultural best management practices. Legislation would be required to authorize use of this fund for lake management and restoration projects.

Financial assistance from this account could be in the form of grants or low interest loans. The principal of a loan program would be to provide low interest, long-term loans for lake improvement projects. Payback money would go back into the account and would be made available for reallocation to other water quality improvement projects.

Legislation to authorize a loan program from this account for constructing sewage treatment plants was passed in 1987. Similar legislation could be developed for lake and lake watershed management projects.

Federal Clean Lakes Program

A final alternative for funding lake management projects is the federal Clean Lakes Program. This program is administered by the U.S. Environmental Protection Agency through the Division of Environment. The program consists of Phase I and Phase II projects. Phase I projects include a diagnostic portion to characterize lake conditions and determine sources of impact and a feasibility portion which identifies the actions necessary to restore and maintain water quality. Phase II projects concern the actual implementation of solutions identified during the Phase I study.

Funding for the program in the past several years has been very limited and many restrictions on project eligibility have applied. As a result, Idaho has not been able to fully participate in the program. This situation is in part the reason why a "grass roots" lake management program came to be in Idaho.

Recent changes in EPA program guidance and reauthorization of the Clean Water Act have, however, revitalized this program. In March of 1987 EPA removed all application restrictions making new Phase I and Phase II projects fundable. Phase I equivalent projects completed using non-federal funds were made eligible to apply for Phase II grants where previously they were not. What this means is that the citizen-financed studies can now compete for Phase II grants if they have adhered to federal Phase I project requirements. It also means that citizen groups concerned about degrading lake water quality can seek funding for studies and remedial plans (Phase I) under the federal Clean Lakes Program.

The federal Clean Lakes Program is yet another option for solving lake water quality problems. Although the application and review process is extremely competitive and rigorous, it is one of the few viable sources of funding for the very costly remedial actions that are often necessary to restore water quality.

Grant applications are generally submitted to EPA in April of each year. Citizen groups interested in participating in this program should contact the Clean Lakes Coordinator of the Division of Environment in Boise or the local field office.

In conclusion, the solutions to problems of lake and lake watershed management are costly and complex. There are, however, many resources at hand that can be drawn upon to solve these problems. Concerned citizens are the greatest resource with the most power to influence change. The challenge for citizen groups is to:

1) Increase understanding of lake and watershed land use impacts to the extent that individual contributions to the problems are controlled.

2) Get to know the area resource management agencies, their responsibilities, the programs they administer and ask for their help. Be patient but persistent as these agencies are there to serve you.

3) Become familiar with local government and community leaders and state government and legislators. One of the greatest powers to influence change citizens have is through their vote. Make lake management a political issue and be relentless in your demands for action.

The information in this guide is intended to provide citizen groups with the tools, resources and choices for lake water quality protection and enhancement. If you use these, the success of lake management in Idaho is sure to diversify and increase.

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APPENDIX A

NALMS BOOKLET

(See back cover pocket)

APPENDIX B

CASE STUDIES

Cascade Reservoir water quality

Prospects for improvements looking up

Cascade Reservoir is a U.S. Bureau of Reclamation project located on the North Fork Payette River in Valley County, Idaho. The reservoir was authorized by Congress in 1946 and built specifically to provide storage for downstream irrigation and for power production. The reservoir also provides a wide range of recreational opportunities including boating, fishing, swimming, and water skiing. These are "secondary" uses, however, as compared to the congressionally authorized uses of irrigation and power production.

A 1980 report by the Idaho Department of Fish and Game lists Cascade Reservoir as the number one fishery in the state of Idaho. This rating is based on the number of anglers using the reservoir and the total pounds of game fish harvested. More importantly, an angler preference poll identified Cascade as the most preferred body of water for fishing.

Naturally, when the water quality began showing signs of deterioration, users of the reservoir made their concerns known. In the early 1980's, homeowners around the reservoir became concerned by an increase in algal blooms, fish kills, and bacterial contamination of swimming waters. They organized into a group called "Concerned Citizens for Cascade Reservoir" (CCCR). CCCR sponsored several public information and education meetings with congressional and state legislators to bring attention to the problems of the reservoir.

CCCR stimulated the various government agencies responsible for managing the reservoir to work together toward solving water quality problems in the reservoir. An Interagency Task Force was formally organized in 1985, sponsored by the Valley County Soil Conservation District. Members include representatives from the Bureau of Reclamation, Water Quality Bureau, Department of Fish and Game, U.S. Forest Service, Soil Conservation Service, and the Central District Health Department.

A large shallow body of water, Cascade Reservoir is located on the North Fork of the Payette Rive
This Bureau of Reclamation project was completed in 1948.

Task Force meetings have been held biannually and have been open to the public. Representatives of the Valley County Commissioners, CCCR, and local residents have attended regularly.

Extensive work has been done on the reservoir over the years by many agencies. One of the first steps taken by the Interagency Task Force was to compile all information relevant to reservoir water quality into one report.

This literature review was completed by the Water Quality Bureau in 1986. The report concluded there was sufficient data documenting the water quality problems of the reservoir. Nonpoint source runoff from agricultural lands was identified as the most significant source of pollution to the reservoir. Finally, the report recommended the implementation of Best Management Practices (BMPs) as having the greatest potential for reducing nonpoint source nutrient and bacterial pollution to Cascade Reservoir.

The work of the resource agencies and concerned citizens has already produced results.

- The minimum pool level of the reservoir has been raised by the Bureau of Reclamation which should reduce the risk of fish kills fror dissolved oxygen depletion.
- 1,870 acres of shoreline grazin leases have been withdrawn by th Bureau of Reclamation.
- Tributary water quality monitorin has occurred and more is planne to further identify sources of in pact.
- Fencing the high water line to r strict animal access to the shoreli is planned on U.S. Forest Servi land.
- Higher priority is being placed c water quality projects for cos share funding under some feder agricultural programs, and
- Efforts to get Cascade Reservoir c the state Agricultural Segment P ority List are being made.

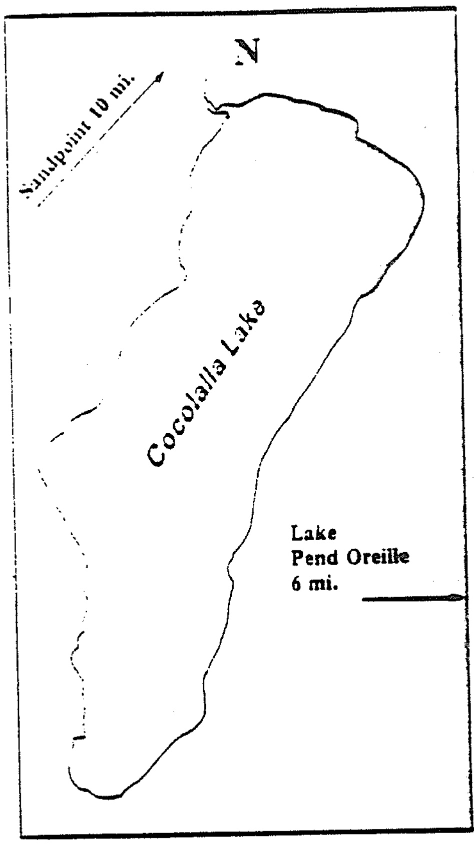
Both agency commitment and citize concern for improving conditions Cascade Reservoir have been clea demonstrated. The challenge now is secure funding and landowner c operation for putting land manageme practices into place.

—*Patricia Kla*

For more information on the Cascade Reserv cause, contact: Jim Haskins, Cascade Reserv Association, 3140 East Franklin Road, Merid Idaho 83642, (208) 888-1236.

Cocolalla Lake

Lake association funds innovative approach to long-term lake management



Cocolalla is an 800-acre lake about 10 miles south of Sandpoint, Idaho. It has all the classic signs of eutrophication: poor water clarity, algae blooms, excessive aquatic weed growth, and oxygen depletion in bottom waters. The lake is especially prone to accelerated aging or "eutrophication" due to its shallow mean depth of seven meters.

The visible deterioration in water quality led concerned citizens to organize and begin action to protect Cocolalla Lake. The Cocolalla Lake Association, born in April 1985, has over 100 members determined to reverse the deteriorating condition of the lake.

The Cocolalla Lake Association looked to other active lake groups in the area for ideas on how to approach their problem. The logical first step seemed to be to conduct a water quality study as had been done by others. The cost of a one-year study began at $15,000. Their young association had not been in existence long enough to have such large cash reserves. The desire and urgency for action couldn't wait for that kind of money to be raised.

The group chose a more innovative approach to managing the future of the Cocolalla Lake. The University of Idaho was contracted by the association to develop a lake/watershed model for Cocolalla to predict changes in lake conditions in response to changes in watershed activities. The modeling approach uses relationships that have been established through data collected on other lakes to predict responses in lakes where there is limited data. The cost of this approach is reduced because of the limited field work and sample analysis required.

The lake association raised $6,300 among its members and the Cocolalla Lake/Watershed Model project was begun in March 1985. The project is expected to be completed by early 1987.

So what will the Cocolalla Lake Association have when its all over? The management model will take the form of a computer program for an IBM personal computer (or IBM-compatible). The principle of the model is to predict nutrient (phosphorus) loading to Cocolalla Lake and the resulting changes in lake phosphorus concentration, chlorophyll, and transparency. Different watershed management scenarios will change nutrient loads, hence the lake's response. The model will therefore allow the lake association to "try out" different management measures on the computer to evaluate which will be the most beneficial and cost effective to actually implement.

Cocolalla's approach to long-term lake management may benefit many area lakes. If the predictive capabilitie of the model are borne out, the sam approach could be used elsewhere. Th model could be adjusted to the specif lake of concern by providing input c watershed and water quality data fo that lake.

More will be known once manag ment practices are installed and C colalla Lake begins to respond. Th Cocolalla Lake Association is in th process of finding funding to do ju that. The group has shown its resourc fulness in taking this first, somewh innovative step. There is little dou they will be able to raise the mon and/or impetus for action to impro the quality of Cocolalla Lake.

If you would like more informatic on the Cocolalla Lake experience, co tact:

Alan Carlson (509) 922-1368
4519 N. Ely Rd.
Spokane, WA 99212

Cocolalla Lake is a natural lake located ten miles south of Sandpoint, Idaho. The watershed is mostly forested with agricultural and grazing land along inlet streams. Grazing land is also visible along the south shore. The lakeshore is 100 percent privately owned and is about 60 percent developed with about 85 dwellings. The east shore is not available for development because of railroad right-of-way and Highway 95 adjacent to the lake. Emergent vegetation (bulrushes) is present along the east shore. The one public access is on th north end, and it has a boat ram and a picnic area.

Spirit Lake

Homeowners' group forges ahead in efforts to protect lake

The Spirit Lake Property Owners Association has been around for 15 years or so — long enough to notice visible changes in the condition of Spirit Lake. These obvious changes in lake conditions along with a proposal to construct a large marina on the east shore led to the group's formation.

The marina was proposed back in the early seventies and as it turns out was never built. The possible threat to water quality this project posed was the turning point, however, for the Spirit Lake Property Owners. It provided the impetus to organize and brought attention to the more subtle changes occurring in the lake that needed to be addressed. Members recognized that in order to reverse the trend in the lake: 1) credible data had to be collected, 2) communication with agency decision makers had to be established and 3) continued monitoring of lake conditions had to occur.

Spirit Lake is located in northwestern Kootenai County in the Panhandle area of Idaho. It has a surface area of 1,446 acres, mean depth of 37 feet and maximum depth of 100 feet. The major tributary, Brickle Creek, enters the lake on the west end. The single surface outlet is Spirit Creek, at the northeast end of the lake. There is also significant ground water recharge from the lake to the underlying Rathdrum Prairie Aquifer.

The lake's drainage area is about 48 square miles. About 80% of the watershed is privately owned; 90% of this area is forested. There is also some grazing in bottomlands adjacent to Brickle Creek. Recreational use is heavy and there is dense summer home development along the northern and eastern shorelines. Year around residences are increasing and almost all use on-site subsurface sewage disposal.

Spirit Lake water quality has historically been excellent. Subtle changes in recent years, like decreased water clarity and increased aquatic plant growth, prompted the homeowners' association to pursue a water quality study. In 1984 the 200 members passed the hat and raised $14,000 to contract a water quality study with Eastern Washington University. The study objectives were to scientifically verify the decline in water quality noticed by long time residents, identify possible sources of impacts and recommend actions needed to reduce impacts on water quality.

Mike Beckwith

Bud Anderson, Spirit Lake Property Owners Association and Gwen Burr, Water Quality Bureau, sample through the ice on Spirit Lake.

Study results showed a decline in water quality due to excessive nutrients inputs. Eighty percent of the nutrients were coming from watershed land uses, 10% from subsurface sewage disposal systems and 10% from the atmosphere. Recommendations emphasized continued monitoring, increased citizen understanding and participation in land use and water quality management and efforts to reduce individual impacts on lake water quality.

The Homeowners' Association is already acting on several of the study recommendations. A cooperative monitoring program between the association and the State water pollution control agency is in progress. Monitoring began in 1985 as a followup to tr original study. The study objective were to better define nutrient input identify trends in lake water quality an provide training for the lake associatio to continue monitoring on their own.

The lake association has gone or step further and contracted with th University of Idaho to better identi land use impacts on Brickle Creek, th major tributary to Spirit Lake. Onc again the hat was passed and ove $9,000 was raised to complete the stud The objective of this study is to de termine exact nutrient inputs from lan use activities in the Brickle Creek drair age so that management practices t reduce impacts can be installed appro priately. The study will be completed i early 1988.

So what does the Spirit Lake Home owners' Association have in mind fc their next move? The condition of Spir Lake and possible sources of impac have been characterized. Training i water quality monitoring has been ol tained to allow association members t continue keeping an eye on condition Specific land use activities in the Brickl Creek drainage are being evaluated t provide the focus necessary for wate shed management action. When equip ped with all the facts the group plans t forge ahead with a call for action. Th first order of business is to get th county government's attention. The cour ty must acknowledge and accept re sponsibility for problems and solution within their control. The next step wi be to politicize long-term lake manag ment needs and to obtain public commi ments by political leaders for action.

If you would like more informatio on the Spirit Lake experience contact

Bud Anderson (208) 623-2791
Christmas Tree Resort
Spirit Lake, Idaho 83869

Twin Lakes

Lake Improvement Association is revitalized and takes action to protect lake

The Twin Lakes Improvement Association will have its 30-year anniversary in August 1987. Some may wonder why, after thirty years, all the activity around Twin Lakes lately. New blood in the organization and talk between the neighbors about declining water quality has renewed concern to the point of action by the lake association.

Twin Lakes, located in northwestern Kootenai County, Idaho has two distinct but connected basins. The upper basin is quite shallow with a mean depth of 11 feet and a maximum depth of 17 feet. The lower basin's mean depth is 23 feet and maximum depth is 63 feet. Both have classic symptoms of "eutrophication" or accelerated aging. Conditions in the upper basin are more severe owing to its shallow depth and the influence of tributary inflows. Water quality conditions that have hampered the use and enjoyment of Twin Lakes include poor water clarity, algae blooms and excessive aquatic weed growth.

Concern for the future of the lakes led the Twin Lakes Association to hire the University of Idaho to conduct a study and develop a plan of action for improving water quality. The study objectives were to determine the condition of the lakes, identify sources of impact and develop a lake management plan to reduce impacts and improve water quality. The two-year study cost the association $17,000; the 250 association members put up $12,000 and $5,000 was provided as a grant from the State Department of Water Resources.

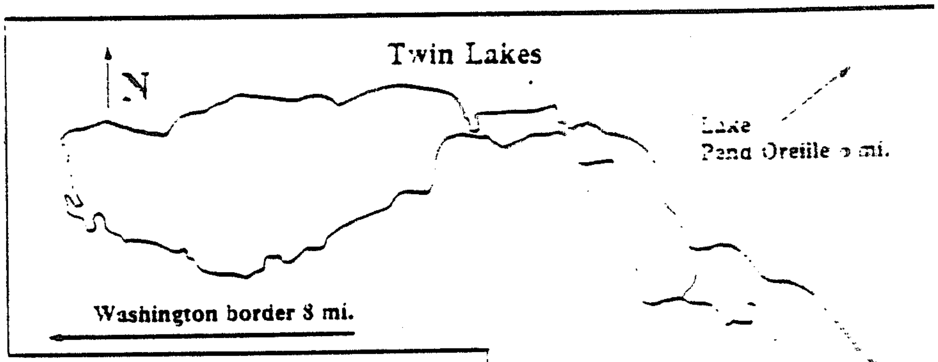
There are many activities conducted in the Twin Lakes drainage that may be contributing to problems in the lakes. The watershed is 90% forested with 70% in private ownership. The east shore is completely developed with both summer and year around residences. There are about 800 homes within a half mile radius of the shoreline, all on individual subsurface sewage disposal systems. There is also a large cattle ranch at the head of upper Twin where the main tributary enters the lake. Finally, the level of the lakes is controlled at the outlet on the lower lake by flood gates. There are down stream water rights that must be maintained and recharge to the Rathdrum Prairie Aquifer complicates water level management. There are also irrigation water withdrawals that may significantly increase with the proposed development of a 9-hole golf course.

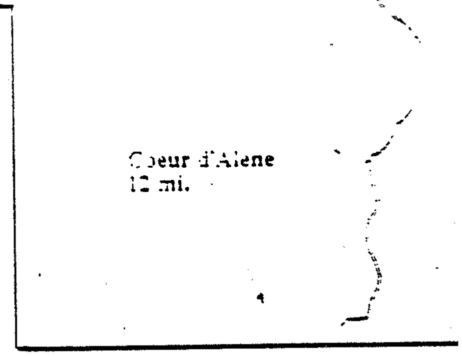
These many activities may be a blessing in disguise for Twin Lakes. Th variety of potential sources of impact also represent a variety of possible solu tions. By the same token, funding pros pects for implementing solutions ar also increased. State and federal pro grams are in place that finance specifi resource improvement or managemen projects. Planning and zoning decision may also be needed. These possibilities make for a long term course of actio in behalf of protecting Twin Lakes.

The lake study results and manage ment plan were in the association hands for review by last Decembe Before the next recreation season loc for the Twin Lakes Improvement A sociation knocking on agency doors f action on the management plan.

If you would like more informatic on the Twin Lakes experience, contac

Mary McMillion (208) 687-1544
N. 1900 Marilyn Rd.
Rathdrum, Idaho 83858





Twin Lakes are natural lakes located 12 miles northwest of Coeur d'Alene, Idaho. The water level of the lakes is artificially controlled by a dam on lower Twin. The watershed is almost entirely forested with some agriculture occurring along the primary lake inlet on the east end. The lakeshore is 95 percent privately owned and is about 60 percent developed. The northern and eastern shorelines are almost entirely developed. Steep terrain and limited road access have prevented much development along the southern and western shorelines. There are five public access points on the lake: two on upper Twin and three on lower Twin.

Conclusion of a two-part series

Lake protection associations

In this issue, **Idaho Clean Water** concludes its two-part series on Idaho's lake protection associations. In the Winter 1986/1987 issue, the newsletter examined the Cocolalla Lake, Spirit Lake, and Twin Lakes protection associations and concludes the report in this issue with a look at the associations for **Hauser Lake, Cascade Reservoir**, and **Hayden Lake**. (See pages 4, 5, and 7.)

With the exception of Cascade Reservoir, all of the associations discussed in this series are members of the North Idaho Lakes Association Coalition (NILAC). Lake management is not, however, just a northern Idaho problem but one that is statewide. Similar actions are occurring in central Idaho at Winchester Lake and Cascade Reservoir, and in southeastern Idaho at Bear Lake (see **Bear Lake** story, page 8).

The progress these groups have made in lake protection has occurred with little or no financial support from government. This situation could be changing. Recent reauthorization of the Federal Clean Water Act includes several programs which could benefit Idaho lakes. The Clean Lakes Program (Section 314) and the Nonpoint Source Control Program (Section 319) are two.

The U.S. Environmental Protection Agency (EPA) administers these programs through Idaho's Water Quality Bureau. Guidance for 1988 should be available from EPA sometime this fall.

The Bureau is also in the process of updating the State Agricultural Program Priority List. Lakes on this list can apply for funding to solve agriculturally related pollution problems. This update should be completed by late summer 1987.

Idaho lake protection groups are to be congratulated for their personal investment and accomplishments in lake protection. It is the Water Quality Bureau's hope to provide some long awaited financial assistance to solve some of the water quality problems identified through the efforts of the state's lake protection associations. ■

Hauser Lake

Residents form watershed coalition

Yet another citizen's group concerned about lake water quality has formed in north Idaho. Late last year area residents formed the Hauser Lake Watershed Coalition, a nonprofit corporation dedicated to protecting and improving the water quality of this small, shallow lake near the Washington border in Kootenai County.

For several years, Hauser Lake residents have occasionally reported dense scums of floating algae in late summer and fish kills under winter ice cover. Fish caught in late summer are reported to "taste terrible" and last fall, eggs produced by small aquatic "water fleas" covered beaches to depths of several inches. These are all symptoms of a nutrient-rich, or "eutrophic" lake.

Hauser Lake has a surface area of about 550 acres. Over 90 percent of the watershed is forested and privately owned. About half of the shoreline area lies within the City of Hauser.

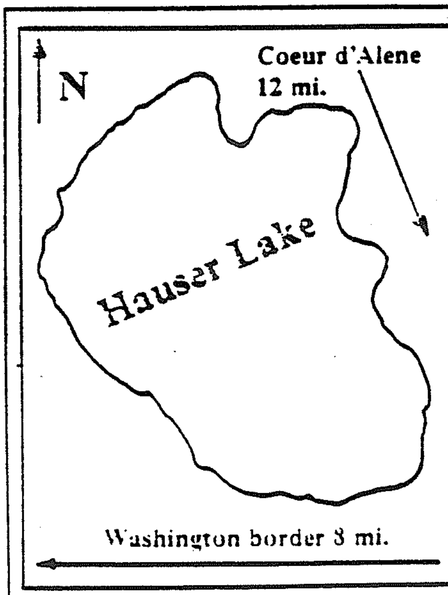
The City of Hauser and the Watershed Coalition are taking steps to determine the causes of the lake's degraded conditions and ways to improve it. The city is in the process of applying for a Wastewater Facilities Planning Grant from the Water Quality Bureau. This grant will be used to assess sewage collection and treatment needs within the city boundaries.

The Watershed Coalition has raised about $2,000 to finance a study of the lake's condition and identify sources of impacts. The hope is to raise enough money to look at the other watershed factors that may contribute to degraded lake water quality.

These two efforts combined will provide a total picture of lake conditions, causes of deterioration, and possible solutions to water quality problems. The Water Quality Bureau will assist both the city and the Watershed Coalition in their efforts to improve the water quality of Hauser Lake. ■

—*Mike Beckwit*

For more information on Hauser Lake, contact Al Sharon, Hauser Lake Watershed Coalition, 702 Saltice Way, Post Falls, Idaho 83854 (208) 773-9365.



Hauser Lake is a natural lake that lies along the northern edge of the Rathdrum Prairie, and is adjacent to the Washington-Idaho border. The watershed is almost entirely privately owned. There is a large public recreation access on the south shore, with a boat ramp, swimming beach, and playing field. There is dense growth of rooted macrophytes throughout the lake. Emergent vegetation, primarily lilies and reeds, is present along the north and west shores. Eutrophication problems have been recognized at Hauser and severe oxygen depletion has taken place in some years. ■

Winchester Lake

Will it be Idaho's first lake rehabilitation project?

Winchester Lake is a small scenic lake located in the middle of Winchester Park thirty miles southeast of Lewiston. Concern for the future of Winchester Lake and the economy of the city of Winchester has recently peaked and things are beginning to happen.

Winchester Lake got the attention of a few key resource management agencies back in 1984. Numerous complaints about poor fishing and foul water quality caused the Water Quality Bureau of the Division of Environment and the Department of Fish and Game to investigate.

The agencies pooled their resources and conducted a water quality study of the lake in 1985. The objectives of the study were to determine the condition of the lake and possible causes of deterioration, and to recommend corrective actions.

At the same time the lake study was being designed, an agricultural planning project on Lapwai Creek was being conducted by the Lewis and NezPerce Soil Conservation Districts. Lapwai Creek is the major tributary to Winchester Lake. The Division of Environment was conducting a water quality study on Lapwai Creek in conjunction with the planning project. The relationship between Lapwai Creek and conditions in Winchester Lake became clear.

Study results verified that Winchester Lake was "eutrophic", or overnourished. The sources of excess nutrients (phosphorus and nitrogen) were from Lapwai Creek and from the lake itself, stored in the bottom sediments. The nutrients contributed to massive mats of blue-green algae which depleted the oxygen supply and created unfavorable conditions for fish.

Recommended actions focused on agricultural and grazing practices in the upper watershed and various in-lake treatments. The objective of these recommendations was to reduce the amount of phosphorus coming into the lake, as well as the amount already there.

So what's happening at Winchester Lake these days? Virtually everyone has rallied to the cause. The Lewis and NezPerce SCDs, Clearwater Resource Conservation and Development Council, Department of Fish and Game, and Division of Environment are providing the technical impetus.

The Department of Parks and Recreation, which operates Winchester State Park, has an obvious stake in the lake. The citizens of Winchester probably have the biggest stake in what happens to Winchester Lake, as their quality of life and economic livelihood depend on the lake's condition. Under the leadership of Mayor Don Heath these people have kept the political heat on to make sure there is a follow-through on recommended actions.

Now that study results are in Mayor Heath has organized a task force to act as decision maker on the fate of Winchester Lake. This group will evaluate technical information provided by the resource agencies, and explore fundi sources for rehabilitating the lake.

Winchester Lake has many thir going for it. Its small size and shall depth make several in-lake restorati methods feasible, such as dredging a alum treatment. The land use impacts the lake's watershed can be reduc through installation of the best man ment practices.

Several possible funding sources e that could finance corrective actic Dingle Johnson funds through the partment of Fish and Game, Agri tural Water Pollution funds through Division of Environment, and Sr Watershed funds through the Cl water Resource Conservation and velopment Council are all possibilit

Last, but not least, Winchester L has the concern and commitment of surrounding community. The citi have forged a close relationship agency personnel, and all parties h pledged their cooperation to reac timely and effective solution. Winc ter Lake could very well be the first rehabilitation project in Idaho!

—*Gwen*

John R Moeller

Winchester Lake: "numerous complaints about poor fishing and foul water quality."

APPENDIX C

ONE AGENCY'S PERSPECTIVE ON LAKE MANAGEMENT
PANHANDLE HEALTH DISTRICT

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ONE AGENCY'S PERSPECTIVE ON LAKE MANAGEMENT
PANHANDLE HEALTH DISTRICT

THE NORTHERN IDAHO EXPERIENCE

The watersheds of the small kettle lakes and the drainage basins of the large lakes of northern Idaho are subject to growth that will convert them to permanent home sites adjacent to the urban center of Spokane. Spokane is the largest city in the area east of the Cascades, west of Minneapolis/St. Paul, south of the Canadian border and north of Boise. Spokane is rapidly moving from a retail center to that of a wholesale distribution point. The city has a large international airport; it is transected by I-90, the only major east-west highway north of Boise between Seattle and Chicago; it has the only railroads running from Seattle-Tacoma-Portland to Chicago and points east and south. Spokane will become the major urban area between the Cascades and the Rockies. Immediately east, scarcely 30 miles, is Kootenai County with its abundance of small and large lakes nestled at the feet of mountainous national forests. It is inevitable that the growth of Spokane will spill eastward into Kootenai county.

If we are to adequately protect our lakes, we must begin to utilize all the skill and resources we have to initiate and maintain a planned growth strategy that incorporates lake carrying capacity as a component of the process. This is an issue of paramount concern for the long-term preservation of northern Idaho lakes.

The normal process of prioritization and listing does not work well when dealing with lake eutrophication. Because of limited staff resources at any regulatory agency, as one begins at the top of the priority list and works to slow a specific lake's deterioration, those lakes lower on the list continue to deteriorate. At some graphic point the lower priority lakes have deteriorated beyond those higher on the list. The matter seems to better lend itself to an encompassing system of management that is based on diverse activities each complementing the other. A management approach that allows the "regulator" to act as a "facilitator." A "facilitator" that orchestrates solutions by directing the enthusiasm of lake groups to appropriate resources. This management strategy is one that takes advantage of opportunities as they arise.

The management system needs to be based on a fundamental sense of direction, not a detailed plan. The direction is marketing a long-term lake management system. Two major factors must be recognized:

1) There is inadequate state or federal funding to accomplish the necessary baseline studies for each lake. Lake homeowner associations must get involved and develop a mechanism to finance their own baseline work. The first step of the long-term strategy is for homeowners to educate themselves.

2) Since a baseline limnological study is necessary in most cases, homeowners should arrange at the earliest opportunity for speakers in limnology to address their associations. University professors or regulatory agency personnel are a good place to start.

The baseline limnological studies will delineate the causes of nutrient contamination. Problem definition allows accurate allocation of limited resources.

The fundamental aspects of a baseline study are defined in the federal Clean Lakes Program Guidance. Citizens, in organizing for such a study, need to tell the potential contractor what they want done. It is a good idea to have the local water quality regulatory agency at that meeting.

There are several potential resources that citizen's groups can tap to get such studies done:

1) Utilizing universities accomplishes several very important things.

   a) Universities are equipped to conduct these academic type studies; equipment and overhead are existing and maintained.

   b) The professional staffs have extensive technical depth and expertise.

   c) Each study can be set up by a graduate student and reviewed by his or her thesis committee before it is approved.

   d) Such studies provide an opportunity for the citizens to be tied in with their universities, thus reinforcing a sense of community.

2) Utilizing private consultants with expertise in limnology. Although this is generally more expensive, consultants can also act as advocates for the citizens in local issues and with state and federal agencies. Consultants are generally well versed in the implementation of remedial actions and political negotiations.

3) Utilizing available agency programs such as the federal "Clean Lakes Program" or the state "Agricultural Water Quality Program." The availability of funding and even of the programs vary with each fiscal year. However, some resources may be available if the specific lake or watershed qualifies.

4) Utilizing the state regulatory agency to develop a monitoring program that citizens can implement. The regulator would interpret the data once it is collected and produce a report.

Any of these approaches or a composite of them should be investigated by the citizens to get "the ball rolling" on their lake. As Albert Einstein said, "A problem well defined is half solved."

After the baseline studies of the lake are completed, the problem, if any, will be defined. The next stage is for the citizens to move to Step 2: define the watershed land use practices. Utilizing the same resources as they did for Step 1, watershed characterization can define existing and potential problems in terms of land use. These studies can be carried out after the baseline limnology work is done. These become the next stage of the lakes plan. The citizen's group is thus moving out in concentric circles from the lake, to the shoreline, to the watershed.

The result of this study is to determine what is happening on the shore and in the watershed that is affecting the quality of water in the lake. The lake trophic status is a direct result of land use activities. This study will develop best management practices (BMPs) for various activities in the watershed. Activities such as road building, lot landscaping, home building, and agricultural and logging practices can be assigned BMPs so that the least impact to the lake occurs.

The final stage is Step 3. That consists of involvement by the citizens in the local political decision-making process. The BMPs developed for the watershed can be converted into long-term, comprehensive plan modifications enforced by county zoning and building ordinances. The political conversion needs to be carried out by the citizen's group that has been involved in each lake plan since its inception.

The hub of this entire strategy is the local citizen's groups. They may be a homeowner's association, a sewer district, or a watershed improvement district. They are the core group that has the most to lose from any adverse impacts to their lake. They are a powerful financial and political entity that at times fails to realize their potential because they may lack organization and direction for a long-term technical endeavor. They are, however, the natural core of any successful lake management strategy. Lake homeowners have the most to lose from cultural eutrophication; they are nutrient contributing factors who can change their activities and thus make a difference; they can present a united front that helps implement corrections by mutual coercion; they are a vital political force that can clamor for change that regulatory agencies cannot achieve alone; they are a financial source that is not hampered by "red tape" and their financial commitment directly benefits them. But most of all, they are the citizens that ensure a deep-seated, long-term commitment to clean lakes that can withstand changing political winds.

Involving neighborhoods in problem definition and planning has some distinct advantages:

1) Compared to traditional approaches, neighborhood programs are more responsive to local characteristics, desires and problems.

2) Compared to conventional approaches, neighborhood programs result in an increase in the number of citizens participating in problem definition and planning.

3) Neighborhood programs are more project oriented, rather than policy oriented, and result in more local physical improvements and an increase in the political constituency for planning.

4) Neighborhood planning will result in a wider range of problems being addressed by the planning process and an improvement in public services.

5) Neighborhood planning programs will result in more social interaction and a stronger sense of community in local areas.

6) Neighborhood involvement and planning creates a climate of mutual coercion where unacceptable acts such as washing and rinsing your boat in the lake become common knowledge. People can prevent many adverse nonpoint source pollution impacts by peer pressure. Educational slide shows on weekends at association gatherings, pamphlets, water conservation devices, "no fertilizing within 100 feet of lake signs"; all these and more must become common knowledge through neighborhood marketing of long-term lake protection.

One might well ask what are the "regulators" doing while the citizens are doing all of this work.The advantage of this approach to the various regulatory agencies is that it frees their limited staffs to act as facilitators rather than doing raw field work. A staff regulator can facilitate four or five of these studies in the time it would take him to complete one. This presents an image of a more efficient agency by orchestrating solutions and assisting citizen's groups in realizing their goals and objectives. It also develops a more in-depth management staff that sees four, five, or six converging studies developing into an overall program. Thus, information or solutions learned in one watershed can be shared with another. It also gives the staff an opportunity to carry the limnology work into the watershed planning arena (Step 2) after the diagnostic baseline study (Step 1) is completed. Remedial action or enforcement where appropriate is a much better use of limited regulatory staff time than academic baseline studies.

Since nonpoint source pollution on each lake is extremely diverse and is the result of numerous individual and group activities, it is appropriate also that the regulator act as an educator to the homeowners group. As a primary management activity for water quality, including local citizen groups will require a posture of inclusion by the regulator. It is imperative that the regulator/facilitator adhere to some fundamental management positions, and that citizen's groups request these commitments from the agencies.

First, the inclusion of citizen's groups must be sanctioned by the regulator. They must feel involved and that they have influence in the process. The regulator cannot hedge his commitment. Every opportunity should be taken in the press and on television and radio to endorse local citizen involvement.

Second, there must be constant communication between and among the groups and the facilitator. This provides a network of support and an ability to share information. It reduces the possibility of conflicts due to a difference in expectations.

Third, the facilitator agency must adapt a portion of its resources to review, help, and support the local citizen's group in accomplishing their objectives. The citizen organization will be a volunteer group that is committing itself to accomplishing tasks that are mutually beneficial. Their commitment will be at the expense of other leisure activities they could be engaged in. It will be imperative that the regulator/facilitator actively help and support their efforts at every available opportunity. This will include night and weekend meetings; document review and comments; strategy planning; and technical assistance. Passive support will assure failure.

Four, the facilitator will need to coordinate the overall results into a regional water quality plan. It will need to "fill the gaps" where active citizen or neighborhood groups do not exist, such as silvicultural activities, interstate water quality coordination, interagency coordination, etc.

Five, the facilitator has to educate the citizen's groups. In terms of technical information this can be accomplished with short training sessions taken to the groups. The educational obligation extends beyond the technical aspect. Groups must be taught who to contact, how to develop strategies, how the local governmental systems work, what resources are available, etc.

These five management postures must be committed to by the regulator/facilitator if a management system using citizen's groups is to work. It will require a "state of mind" rather than a technical activity. If the citizen's groups sense a lack of support or commitment on behalf of the facilitator, this will drain their enthusiasm. In this type of management strategy there is no substitute for enthusiasm. Not all of the groups may be equally successful even with enthusiastic commitment by the facilitator. But no water quality management strategy will be successful without grass-roots citizen suport. Citizens must also actively request these assistances from the facilitator agencies. It is the citizen's right to expect that level of commitment.

Both citizens and agencies must realize that such a management system may have huge success on some lakes, moderate on others, and little success on yet others. Do not fault the management strategy, it simply must be tuned to each lake. Find out what the concerns are and adjust for them. We must rid ourselves of the concept that we <u>need</u> uniform application across the state on all lake programs.

Each lake will rise to the level of commitment given at that time. Some will take longer to mature because the need or concern may be less.

Associations need to band together. In northern Idaho, all of the lakes associations have formed an organization called NILAC (North Idaho Lake Association Coalition). They meet on the 4th Thursday of each month for a luncheon meeting at a local restaurant. They discuss legislation, invite guest speakers, share data, celebrate successes and invite county commissioners to hear them.

Associations and individuals need to educate themselves. They can join the North American Lake Management Society (NALMS). They can have agencies educate them on specific activities, e.g., septic systems, road building, lot erosion, fertilizer and pesticide use, aquatic weed control, fisheries habitat, comprehensive plans, zoning ordinances, interpretation of water quality parameters, water conservation practices, etc.

Associations can develop an educational program for their lake. Have schools develop a logo through contests; design catchy posters and characters, e.g., Woodsy Owl, to carry the message. Have educational information at conspicuous locations such as docks, stores, resorts. Remember a change in values or belief is exponentially more effective than enforcement. Changing how and why people believe is a worthwhile Lake Homeowner objective.